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QUARTERLY REPORT #5
VOLUME 3
PART IV-VI

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QUARTERLY REPORT #5

FIELD DATA

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UTAH STATE UNIVERSITY

Soils Laboratory

Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE ____ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in ~~Inches~~ Cm	Horizon	Particle Size Distribution (in mm.) (percent) Very coarse sand 2-1	Coarse sand 1-0.5	Medium sand 0.5-0.25	Fine sand 0.25-0.10	Very fine sand 0.10-0.05	Silt – Hydrometer –	Clay	% Sand	% > 2 mm.	Textural Class	
As	9	#67	0-5		10	9	12	19	9	27	14	59	39	SL	
	10		5-12		13	8	8	20	15	28	15	57	60	SL	
	11		12-25		14	9	7	16	12	34	14	52	67	SL	
	12		25-35		18	12	8	20	11	22	13	65	63	SL	
A	13	#68	0-8		7	4	4	15	18	38	14	48	28	L	
	14		8-20		10	6	4	13	12	40	20	40	55	L	
	15		20-33		22	11	5	8	7	35	17	48	44	L	
	16		33-50		17	10	6	13	10	36	17	47	77	L	

Soil		pH Saturated Paste	pH 1:5	Organic Matter Organic Matter %	Organic Carbon %	Nitrogen %	C/N	Total Soluble Salts %	Electrical Conductivity EC x 10^3 Millimhos per cm @25°C	CaCO3 equivalent per cent	Gypsum me./100g soil	Gypsum %	Moisture Tensions 1/3 Atmos. %	15 Atmos. %	Liquid Limit %
As	9	8.0			1.4				.5	7.0			17.7	8.1	27
	10	8.2			1.5				.6	8.6			21.2	9.9	37
	11	8.7			1.2				1.0	10.7			23.9	9.4	35
	12	8.9			.6				1.8	7.9			18.2	6.7	30
A	13	8.1			1.5				.5	2.9			17.3	7.8	24
	14	8.1			1.4				.5	8.4			23.0	11.7	33
	15	8.6			1.0				.8	9.8			26.0	9.9	31
	16	8.7			.9				1.2	5.3			25.4	11.8	32

Soil		Cation Exchange Capacity ← NH4OAc me/100g	Extractable Cations Ca	Mg	Na	K →	Avail P ppm	Saturation Extract Soluble Na ← milliequivalents per liter	K	CO3	HCO3	Cl	SO4 →	Per cent Moisture at Saturation	Plastic Index %
As	9			.4	.4	.3	6.9							38	NP
	10			1.0	1.3	.1	1.6							52	NP
	11			1.6	7.2	.1	1.1							51	NP
	12			1.6	8.4	.1	.8							40	NP
A	13			1.0	.5	.3	7.5							32	NP
	14			1.1	1.1	.2	2.1							47	3
	15			.6	4.6	.1	1.1							44	3
	16			.6	10.4	.2	2.8							48	4

UTAH STATE UNIVERSITY
Soils Laboratory
Logan, Utah
SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE LOCATION Oil Shale Ua and Ub

Soil LABORATORY NUMBER	COLLECTOR'S NUMBER	DEPTH IN ~~INCHES~~ Cm	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (percent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	% SILT – Hydrometer	% CLAY	% Sand	% > 2 mm.	TEXTURAL CLASS	
W 17	#75	0-10		7	1	1	1	2	62	23	15	0	SiL	
18		10-20		<1	1	1	5	9	60	17	23	0	SiL	
19		20-30		1	1	<1	1	2	59	38	3	0	SiCL	
20		30-65		<1	<1	<1	1	2	64	34	2	0	SiCL	
21		65-90		<1	<1	1	40	31	17	8	75	0	SL	
22		90-130		<1	<1	<1	29	37	23	8	69	0	SL	
23		130-195		1	1	<1	2	4	68	17	15	0	SiL	

Soil	pH SATURATED PASTE	pH 1:5	ORGANIC MATTER ORGANIC MATTER %	ORGANIC CARBON %	NITROGEN %	C/N	TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY EC × 10^3 MILLIMHOS PER CM @25°C	CaCO3 equivalent per cent	GYPSUM me./100g SOIL	%	MOISTURE TENSIONS 1/3 ATMOS. %	15 ATMOS. %	Liquid Limit %
W 17	8.2			5.1				1.4	11.3			34.3	14.7	47
18	8.2			1.1				1.5	11.0			22.2	8.4	26
19	8.0			1.2				14.0	12.0			32.0	15.4	39
20	8.1			1.0				24.0	11.4			30.9	12.6	33
21	8.2			.3				16.0	6.0			7.7	3.8	*
22	8.3			.5				16.0	7.1			9.8	4.1	*
23	8.1			.8				28.0	12.3			31.0	9.3	31
													*Too	Sandy

Soil	CATION EXCHANGE CAPACITY ← NH4OAc me/100g	Extractable CATIONS Ca	Mg	Na	K →	Avail P ppm	SATURATION EXTRACT SOLUBLE Na ← milliequivalents per liter	K	CO_3	HCO_3	Cl	SO_4 →	PER CENT MOISTURE AT SATURATION	Plastic Index %
W 17			5.5	1.3	2.7	27							67	8
18			4.0	1.6	1.7	2.1							47	2
19			8.9	7.8	1.5	2.0							65	16
20			11.5	13.3	.7	2.0							60	12
21			4.5	4.6	.2	1.2							33	*
22			5.8	5.7	.1	.7							34	*
23			10.0	13.3	.3	.7							51	6
													*Too	Sandy

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Logan. Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE LOCATION Oil Shale Ua and Ub

Laboratory Number Soil	Collector's Number	Depth in ~~Inches~~ cm	Horizon	Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt	% Clay	% Sand	% > 2 mm.	Textural Class	
				Particle Size Distribution (in mm.) (percent)					– Hydrometer –					
E 24	#76	0-10		2	2	3	15	32	31	8	61	2	SL	
25		10-23		1	1	2	9	23	41	16	43	1	L	
26		23-47		1	1	1	6	24	45	23	32	0	L	
27		47-75		3	3	6	20	17	33	19	48	3	L	
28		75-120		4	6	8	22	14	29	14	57	14	SL	
29		120-150		8	8	9	22	13	25	14	61	26	SL	

Soil	pH Saturated Paste	pH 1:5	Organic Matter %	Organic Carbon %	Nitrogen %	C/N	Total Soluble Salts %	Electrical Conductivity EC × 10^3 Millimhos per cm @25°C	CaCO3 equivalent per cent	Gypsum me./100g soil	Gypsum %	Moisture Tensions 1/3 Atmos. %	Moisture Tensions 15 Atmos. %	Liquid Limit %
E 24	8.2			.6				.5	5.2			11.8	5.0	20
25	8.2			.5				.7	12.5			17.3	7.1	22
26	8.4			.4				.7	18.7			23.0	9.4	27
27	8.6			.3				.9	11.9			21.6	8.6	23
28	8.1			.4				4.2	9.4			16.8	6.9	23
29	8.0			.4				18.0	7.8			16.1	6.4	22

Soil	Cation Exchange Capacity	Extractable Cations Ca	Mg	Na	K	Avail P ppm	Saturation Extract Soluble Na	K	CO_3	HCO_3	Cl	SO_4	Per cent Moisture at Saturation	Plastic Index %
	←	NH_4OAc me/100g			→		←	milliequivalents per liter				→		
E 24			1.5	.3	.4	7.9							31	NP
25			2.6	.6	.2	1.3							33	NP
26			3.3	1.7	.2	.8							37	8
27			2.4	3.5	.2	.7							31	1
28			1.7	5.2	.1	1.0							34	NP
29			1.7	10.1	.2	1.4							30	NP

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Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth ~~in~~ cm	Horizon	Particle size distribution (in mm.) (percent): Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt – Hydrometer --	% Clay	% Sand	% > 2 mm.	Textural Class
F	8	#39	0-4		2	11	30	29	8	9	8	83	4	LS
	9		4-17		6	13	30	25	6	11	11	78	7	SL
	10		17-35		11	19	27	21	5	8	10	82	25	LS
Ds	11	#40	0-6		7	9	15	27	12	22	12	66	18	SL
	12		6-31		11	10	13	23	12	24	9	67	21	SL
	13		31-137		12	12	14	23	11	21	9	70	23	SL

Soil		pH: Saturated Paste	1:5	Organic Matter: Organic Matter %	Organic Carbon %	Nitrogen %	C/N	Total Soluble Salts %	Electrical Conductivity EC x 10³ Millimhos per cm @25°C	CaCO3 equivalent per cent	Gypsum: me./100g Soil	%	Moisture Tensions: 1/3 Atmos. %	15 Atmos. %
F	8	8.1			.5				.6	3.0			8.1	4.6
	9	8.2			.5				.5	3.7			9.3	5.8
	10	8.5			.5				.3	6.8			10.4	6.3
Ds	11	8.0			.9				.9	13.4			13.9	6.0
	12	8.3			.5				.4	9.7			11.9	5.7
	13	8.2			.5				1.9	7.8			12.9	6.2

Soil		Cation Exchange Capacity ← NH₄OAc	Extractable cations ~~ppm~~: Ca	Mg	Na	K →	Avail P ppm	Saturation extract soluble: Na ← milliequivalents per liter	K	CO3	HCO3	Cl	SO4 →	Per cent Moisture at Saturation
F	8			1.0	.3	.4	16							29
	9			1.3	.5	.2	3.2							32
	10			1.0	.5	<.1	1.0							38
Ds	11			1.9	.4	1.1	24							34
	12			1.9	.4	.7	4.9							32
	13			2.3	2.8	.2	3.5							33

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Logan. Utah
SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE LOCATION Oil Shale Ua and Ub

					PARTICLE SIZE DISTRIBUTION (in mm.) (percent)									
Soil	LABORATORY NUMBER	COLLECTOR'S NUMBER	DEPTH IN ~~INCHES~~ cm	HORIZON	VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	% SILT – Hydrometer	% CLAY	% Sand --	% > 2 mm.	TEXTURAL CLASS
As	14	#42	0-6		9	16	15	19	8	23	10	67	29	SL
	15		6-13		10	15	14	20	9	28	10	62	27	SL
	16		13-41		15	10	8	17	9	36	10	54	31	SL
	17		41-60		14	9	5	13	14	40	13	47	28	L
Ds	18	#45	0-4		8	7	9	22	13	31	12	57	22	SL
	19		4-23		9	10	12	26	12	25	12	63	31	SL
	20		23-40		7	9	11	24	12	26	11	63	18	SL
	21		40-76		7	7	9	22	13	26	13	61	18	SL
	22		76-121		11	13	13	21	8	20	13	67	41	SL

		pH		ORGANIC MATTER							GYPSUM		MOISTURE TENSIONS	
Soil		SATURATED PASTE	1:5	ORGANIC MATTER %	ORGANIC CARBON %	NITROGEN %	C/N	TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY EC x 10³ MILLIMHOS PER CM @25°C	CaCO3 equivalent per cent	me./100g SOIL	%	1/3 ATMOS. %	15 ATMOS. %
As	14	8.1			1.5				.5	7.4			15.0	8.0
	15	8.1			2.4				.3	10.7			20.6	12.7
	16	8.5			1.2				.4	13.6			20.3	8.7
	17	8.6			.8				1.9	12.6			21.3	8.9
	18	7.9			.8				.4	6.0			13.8	6.2
	19	8.2			1.0				.3	8.1			12.9	7.2
	20	8.3			.6				2.4	8.3			13.8	7.5
	21	8.2			.4				13.0	7.6			14.9	7.8
	22	8.3			.2				19.0	9.7			13.7	7.1

			Extractable CATIONS ~~ppm~~					SATURATION EXTRACT SOLUBLE						
Soil		CATION EXCHANGE CAPACITY ←	Ca	Mg NH$_4$OAc	Na	K →	Avail P ppm	Na ←	K	CO$_3$ milliequivalents per liter	HCO$_3$	Cl	SO$_4$ →	PER CENT MOISTURE AT SATURATION
As	14			.8	.3	.2	3.8							38
	15			1.0	.4	.1	2.2							58
	16			2.7	1.0	.1	.5							52
	17			5.2	6.4	.1	.3							51
Ds	18			.7	.3	.4	3.3							29
	19			1.2	.4	.2	1.0							41
	20			2.0	3.3	.1	.3							34
	21			2.4	9.7	.1	.3							35
	22			2.9	14.0	.1	1.5							33

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Soils Laboratory

Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE ________ LOCATION Oil Shale Ua and Ub

Soil	LABORATORY NUMBER	COLLECTOR'S NUMBER	DEPTH IN ~~INCHES~~ Cm	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (percent)								% > 2 mm.	TEXTURAL CLASS
					VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	% SILT	% CLAY	% Sand		
										– Hydrometer --				
A	23	#46	0-6		18	9	4	8	11	40	13	47	23	L
	24		6-20		12	7	3	5	6	62	13	25	35	SiL
	25		20-45		12	7	3	5	6	59	14	27	34	SiL
N	26	#48	0-9		1	1	3	16	33	33	10	57	1	SL
	27		9-20		<1	1	2	12	26	34	27	39	1	L
	28		20-34		<1	1	2	8	15	35	38	27	0	CL
	29		34-55		<1	1	3	12	16	35	31	34	1	CL
	30		55-89		<1	1	2	7	21	40	30	30	0	CL
	31		89-158		1	2	2	8	17	46	26	28	2	L

Soil		pH		ORGANIC MATTER							GYPSUM		MOISTURE TENSIONS	
		SATURATED PASTE	1:5	ORGANIC MATTER %	ORGANIC CARBON %	NITROGEN %	C/N	TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY EC x 10³ MILLIMHOS PER CM @25°C	CaCO3 equivalent per cent	me./100g SOIL	%	1/3 ATMOS. %	15 ATMOS. %
A	23	8.0			1.1				.5	8.3			20.1	7.3
	24	8.3			1.2				.4	23.4			28.9	9.6
	25	8.7			1.0				1.1	16.4			32.5	9.1
N	26	8.7			.3				.9	4.5			9.8	3.6
	27	8.9			.3				2.4	10.5			26.4	11.3
	28	8.5			.3				14.0	15.2			26.8	14.0
	29	8.2			.2				33.0	15.5			20.2	10.5
	30	8.1			.2				22.0	15.4			18.9	8.3
	31	8.3			.1				20.0	11.7			18.9	8.3

Soil		CATION EXCHANGE CAPACITY	Extractable CATIONS ppm				Avail P ppm	SATURATION EXTRACT SOLUBLE						% Moist. at Sat.
			Ca	Mg	Na	K		Na	K	CO_3	HCO_3	Cl	SO_4	
		← NH_4OAc →						← milliequivalents per liter →						
A	23			2.2	.4	.3	7.3							39
	24			5.0	.9	.1	1.5							56
	25			8.6	3.0	.1	1.5							57
N	26			2.4	1.7	.9	6.4							28
	27			3.9	11.4	.3	3.4							48
	28			5.7	19.8	.2	1.8							62
	29			5.7	19.6	.2	1.0							48
	30			5.0	15.7	.1	1.0							48
	31			5.0	13.5	.2	.6							49

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Logan. Utah
SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE ________ LOCATION Oil Shale Ua and Ub

Soil	LABORATORY NUMBER	COLLECTOR'S NUMBER	DEPTH IN ~~INCHES~~ cm	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (percent)								% > 2 mm.	TEXTURAL CLASS
					VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	% SILT – Hydrometer	% CLAY – Hydrometer	% Sand – Hydrometer		
A	32	#50	0-11		4	3	2	10	18	44	16	40	21	L
	33		11-30		12	6	3	10	13	44	15	41	41	L
	34		30-42		21	13	6	11	8	35	14	51	60	L
	35		42-49		23	14	6	16	7	27	17	56	57	SL

Soil		pH		ORGANIC MATTER				TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY EC × 10^3 MILLIMHOS PER CM @25°C	CaCO3 equivalent per cent	GYPSUM		MOISTURE TENSIONS	
		SATURATED PASTE	1:5	ORGANIC MATTER %	ORGANIC CARBON %	NITROGEN %	C/N				me./100g SOIL	%	1/3 ATMOS. %	15 ATMOS. %
A	32	8.0			1.1				.8	3.9			19.4	9.4
	33	8.2			1.1				.4	15.9			20.7	9.8
	34	9.0			.8				1.1	10.9			26:1	11.2
	35	8.5			.7				5.4	8.5			24.2	11.4

Soil		CATION EXCHANGE CAPACITY	Extractable CATIONS ~~ppm~~				Avail P ppm	SATURATION EXTRACT SOLUBLE						PER CENT MOISTURE AT SATURATION
			Ca	Mg	Na	K		Na	K	CO_3	HCO_3	Cl	SO_4	
		←	NH$_4$OAc			→		← milliequivalents per liter					→	
A	32			2.9	1.0	.8	7.4							36
	33			2.9	1.4	.1	1.1							56
	34			2.6	10.9	.8	1.0							46
	35			3.5	13.5	.2	3.5							46

R E Lamborn

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Soils Laboratory

Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. R. Southard DATE ________ LOCATION Oil Shale Ua and Ub

Soil	Laboratory Number	Collector's Number	Depth in cm	Horizon	Particle Size Distribution (in mm.) (percent)								%	Textural Class
					Very Coarse Sand 2-1	Coarse Sand 1-0.5	Medium Sand 0.5-0.25	Fine Sand 0.25-0.10	Very Fine Sand 0.10-0.05	% Silt – Hydrometer –	% Clay	% Sand	> 2 mm.	
As	52	53	0-8		14	8	6	14	14	31	13	56	32	SL
	53		8-23		10	7	4	11	11	46	10	44	26	L
	54		23-45		11	7	4	11	13	52	10	38	35	SiL
Ds	55	58	0-10		1	2	5	34	24	29	10	61	2	SL
	56		10-34		6	9	16	35	12	14	10	76	6	SL
	57		34-72		12	15	20	29	7	10	6	84	38	LS
	58		72-127		23	14	13	20	8	14	9	77	61	SL

Soil		pH		Organic Matter				Total Soluble Salts %	Electrical Conductivity $EC \times 10^3$ Millimhos per cm @25°C	CaCO3 equivalent per cent	Gypsum		Moisture Tensions	
		Saturated Paste	1:5	Organic Matter %	Organic Carbon %	Nitrogen %	C/N				me./100g Soil	%	1/3 Atmos. %	15 Atmos. %
As	52	7.9			1.5				.5	4.9			17.4	9.7
	53	7.8			1.8				.5	13.4			24.8	12.4
	54	8.7			.7				2.5	12.4			27.6	13.3
Ds	55	9.9			.5				5.0	6.2			11.3	5.8
	56	10.4			.3				12.0	5.7			8.7	6.6
	57	8.0			.3				15.0	5.3			7.6	6.0
	58	8.0			.2				3.5	14.6			10.8	5.8

Soil		Cation Exchange Capacity	Extractable Cations				Avail P ppm	Saturation Extract Soluble						Per cent Moisture at Saturation
			Ca	Mg	Na	K		Na	K	CO_3	HCO_3	Cl	SO_4	
		←	NH_4OAc me/100g			→		←	milliequivalents per liter				→	
As	52			.6	.4	.4	11							41
	53			.7	.9	.1	1.4							58
	54			1.1	8.4	.1	.6							56
Ds	55			1.2	6.9	1.3	8.9							41
	56			.4	10.3	.3	10.9							30
	57			.9	3.1	.1	2.1							26
	58			1.5	1.4	.1	1.8							28

UTAH STATE UNIVERSITY

Soils Laboratory

Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. R. Southard DATE ______ LOCATION Oil Shale Ua and Ub

Soil	LABORATORY NUMBER	COLLECTOR'S NUMBER	DEPTH IN Cm	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (percent)								%	TEXTURAL CLASS
					VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	% SILT	% CLAY	% Sand	> 2 mm.	
										- Hydrometer -				
E	43	55	0-5		3	1	2	14	41	31	9	60	4	SL
	44		5-15		2	2	3	12	35	35	10	55	3	SL
	45		15-40		3	2	3	12	31	39	10	51	5	L
	46		40-120		3	4	4	14	25	38	10	52	6	SL
	47		120-160		3	4	6	16	21	34	12	54	9	SL
A	48	54	0-8		8	5	6	20	17	29	13	58	20	SL
	49		8-17		8	5	6	22	18	29	13	58	16	SL
	50		17-30		16	8	6	15	10	27	19	54	38	SL
	51		30-33		22	13	5	8	5	33	20	47	38	L

Soil		pH		ORGANIC MATTER				TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY $EC \times 10^3$ MILLIMHOS PER CM @25°C	CaCO3 equivalent per cent	GYPSUM		MOISTURE TENSIONS	
		SATURATED PASTE	1:5	ORGANIC MATTER %	ORGANIC CARBON %	NITROGEN %	C/N				me./100g SOIL	%	1/3 ATMOS. %	15 ATMOS. %
E	43	7.7			.7				.8	2.9			10.0	4.8
	44	7.8			.4				.6	3.1			11.0	5.5
	45	7.8			.3				.4	4.9			12.4	5.9
	46	8.0			.4				.8	4.9			13.5	6.3
	47	7.7			.3				16.0	6.0			14.6	6.4
A	48	7.9			.8				.5	6.8			15.0	7.5
	49	7.9			.7				.3	9.3			17.2	9.2
	50	7.9			.8				.3	11.5			20.4	12.0
	51	8.0			.8				.4	7.3			21.0	11.1

Soil		CATION EXCHANGE CAPACITY	Extractable CATIONS				Avail P ppm	SATURATION EXTRACT SOLUBLE						PER CENT MOISTURE AT SATURATION
			Ca	Mg	Na	K		Na	K	CO_3	HCO_3	Cl	SO_4	
		←	NH_4OAc me/100g			→		← milliequivalents per liter					→	
E	43			2.7	.3	1.4	24							33
	44			2.5	.3	.5	2.6							28
	45			2.7	.4	.2	1.8							33
	46			3.4	1.1	.2	1.9							35
	47			4.4	6.7	.3	9.2							34
A	48			10.4	.3	.4	7.1							29
	49			1.5	.3	.1	.6							39
	50			1.9	.5	.1	.5							42
	51			1.9	.8	.1	.6							41

UTAH STATE UNIVERSITY
Soils Laboratory
Logan, Utah

SOIL ANALYSIS REPORT

COLLECTED BY Dr. A. Southard DATE ______ LOCATION Oil Shale Ua and Ub

Soil	LABORATORY NUMBER	COLLECTOR'S NUMBER	DEPTH IN ~~INCHES~~ Cm	HORIZON	PARTICLE SIZE DISTRIBUTION (in mm.) (percent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	% SILT – Hydrometer –	% CLAY	% Sand	% > 2 mm.	TEXTURAL CLASS	
Ds	1	#64	0-10		9	9	11	21	11	27	11	62	13	SL	
	2		10-40		14	14	14	23	9	19	11	70	24	SL	
	3		40-65		12	14	13	20	9	23	12	65	20	SL	
	4		65-113		11	16	15	21	9	21	11	68	15	SL	
	5		113-150		12	12	13	22	11	23	10	67	21	SL	
As	6	#66	0-5		8	10	15	27	9	24	11	65	20	SL	
	7		5-15		7	10	14	28	10	21	10	69	40	SL	
	8		15-30		13	11	12	30	9	19	13	68	52	SL	

Soil		pH SATURATED PASTE	pH 1:5	ORGANIC MATTER ORGANIC MATTER %	ORGANIC CARBON %	NITROGEN %	C/N	TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY EC x 10³ MILLIMHOS PER CM @25°C	CaCO3 equivalent per cent	GYPSUM me./100g SOIL	GYPSUM %	MOISTURE TENSIONS 1/3 ATMOS. %	MOISTURE TENSIONS 15 ATMOS. %	Liquid Limit %
Ds	1	8.1			1.1				.6	5.8			14.2	6.0	23
	2	8.1			.5				.4	5.9			11.8	5.6	21
	3	8.1			.4				.6	9.2			12.4	6.2	21
	4	8.1			.4				2.6	7.5			11.6	5.8	21
	5	8.1			.3				28.0	7.2			13.7	6.0	20
As	6	8.1			1.1				.5	12.6			14.1	6.7	24
	7	8.1			1.4				.4	9.8			15.2	7.5	28
	8	8.0			1.8				.4	17.8			20.3	11.4	36

Soil		CATION EXCHANGE CAPACITY	Extractable CATIONS Ca	Mg	Na	K	Avail P ppm	SATURATION EXTRACT SOLUBLE Na	K	CO₃	HCO₃	Cl	SO₄	PER CENT MOISTURE AT SATURATION	Plastic Index %
		←	NH₄OAc me/100g			→		←	milliequivalents per liter				→		
Ds	1			1.1	.3	.3	17							32	NP
	2			.9	.5	.1	3.6							30	NP
	3			.5	.8	.1	3.7							31	NP
	4			.9	3.8	.1	4.1							33	NP
	5			1.5	12.9	.2	2.4							29	NP
As	6			.5	.4	.2	2.6							38	NP
	7			.7	.4	.1	1.2							46	NP
	8			.8	.4	.1	1.5							50	NP

Results of the boron tests on soil samples from tract Ua and Ub.

Soil	Pedon #	Depth-{cm}(in)	Boron
Ds	#64	10-40 (3.9-15.7)	.3 ppm
	#63	113-150 (44.5-59)	.4
W	#75	30-65 (11.8-25.6)	.4
	#75	130-195 (51.2-76.8)	.2
E	#76	120-150 (47.2-59)	.5
Ds	#45	40-76 (15.7-29.9)	1.4
	#45	76-121 (29.9-47.6)	.9
N	#48	20-34 (7.9-13.4)	1.3
	#48	34-55 (13.4-21.7)	1.0

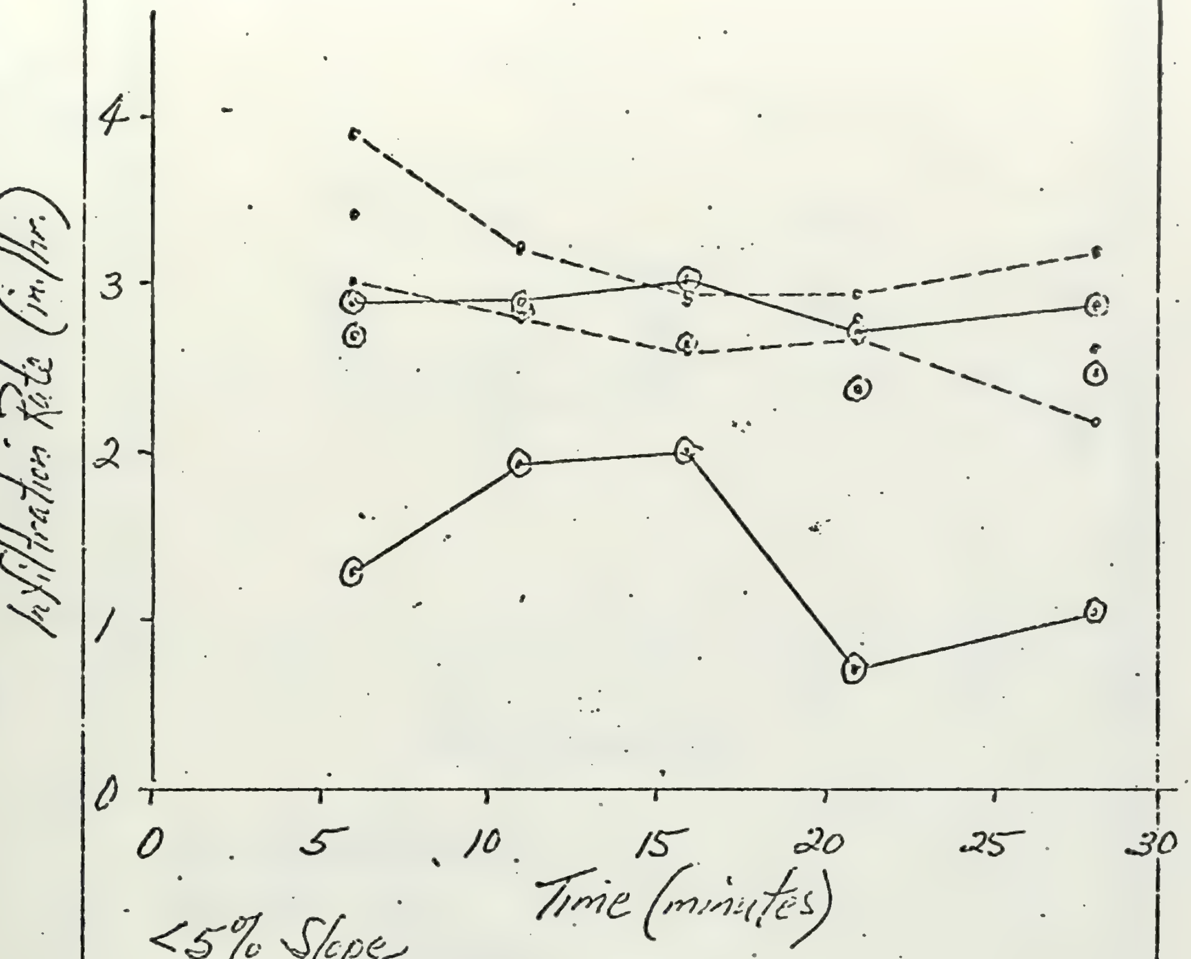
Results of X-ray Analysis of 15 soil samples
from ~~oil shale~~ tracts Ua and Ub

Sample #	Depth (cm)	Quartz	Calcite	Dolomite	Feldspar	Illite	Kaolinite	Montmorillonite
22	25-36	X	X	?	X	X-1	X-1	
37	8-22	X	X		?	X-5	X-5	X-1
38	27-53	X	X		X	X-5		X-1
39	17-35	X	X		X		X-5	X-1
40	31-137	X	X		X		X-5	X-1
42	41-60	X	X	X		?	?	X-1
45	40-76	X	X					X-1
46	20-45	X	X		X	X-4	X-5	X-1
48	55-89	X	X		X	X-2	X-3	X-1
50	11-30	X	X		X			X-1
53	23-45	X	X					X-1
54	17-30	X	X				X-5	X-1
55	40-120	X	X			X-1	X-1	?
58	34-72	X	X		X	X-5	X-5	X-1
63	14-27	X	X	?	X	X-5	X-5	X-1

X means the mineral appears in the less than 2µ fraction. The clay minerals are ranked in order of abundance, with 1 being most abundant and 5 least abundant. Abundances are only estimates.

~~Figure 1~~ (Plots 1,2,3 wet; 1,2,3 dry)

BsC Soil



<5% Slope

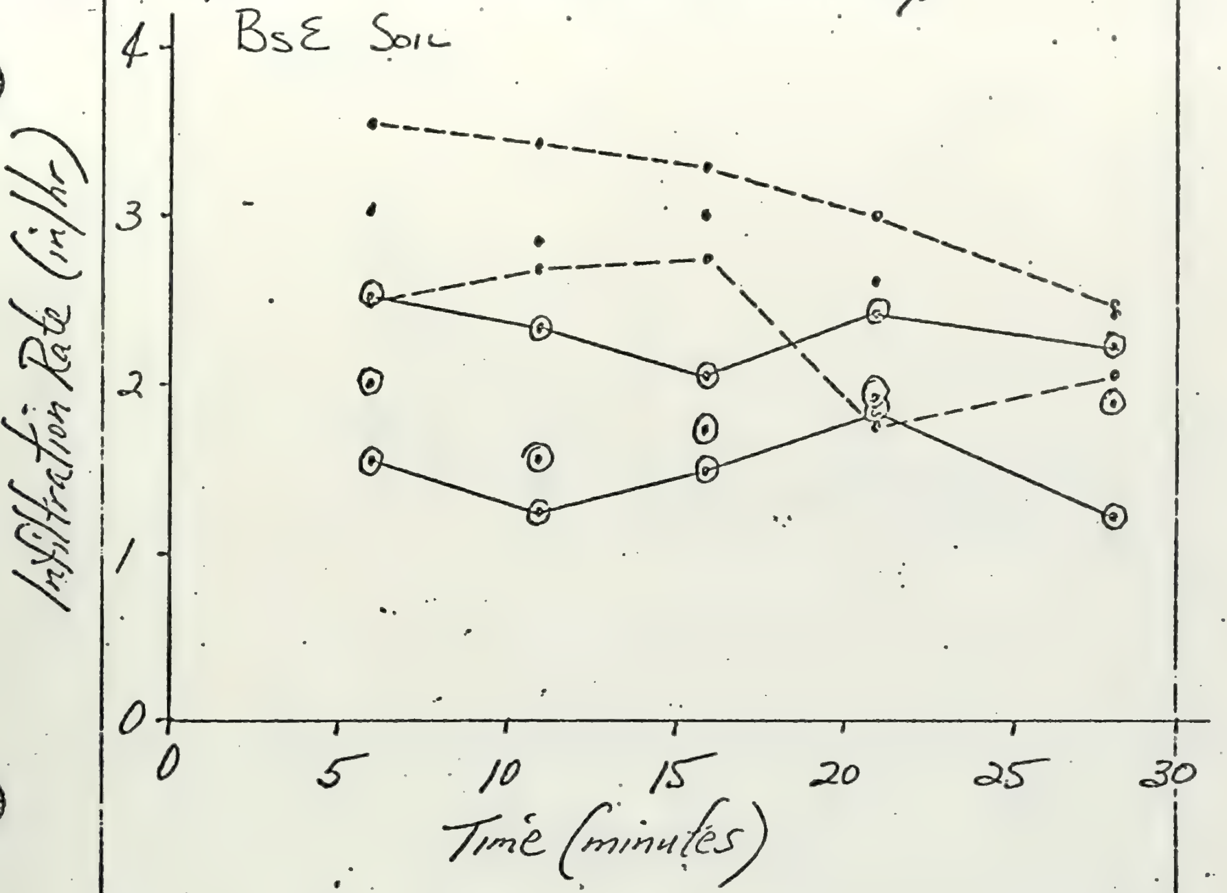
Vegetation: Greasewood
Black Sage
Shadscale
Stipa
Indian Rice Grass

Antecedent Moisture: ——— Wet
------ Dry

Average Percent Bare Soil: 28%

Sediment Yields: Dry $\bar{x}$ = 0.12 tons/acre
Wet $\bar{x}$ = 0.16 tons/acre

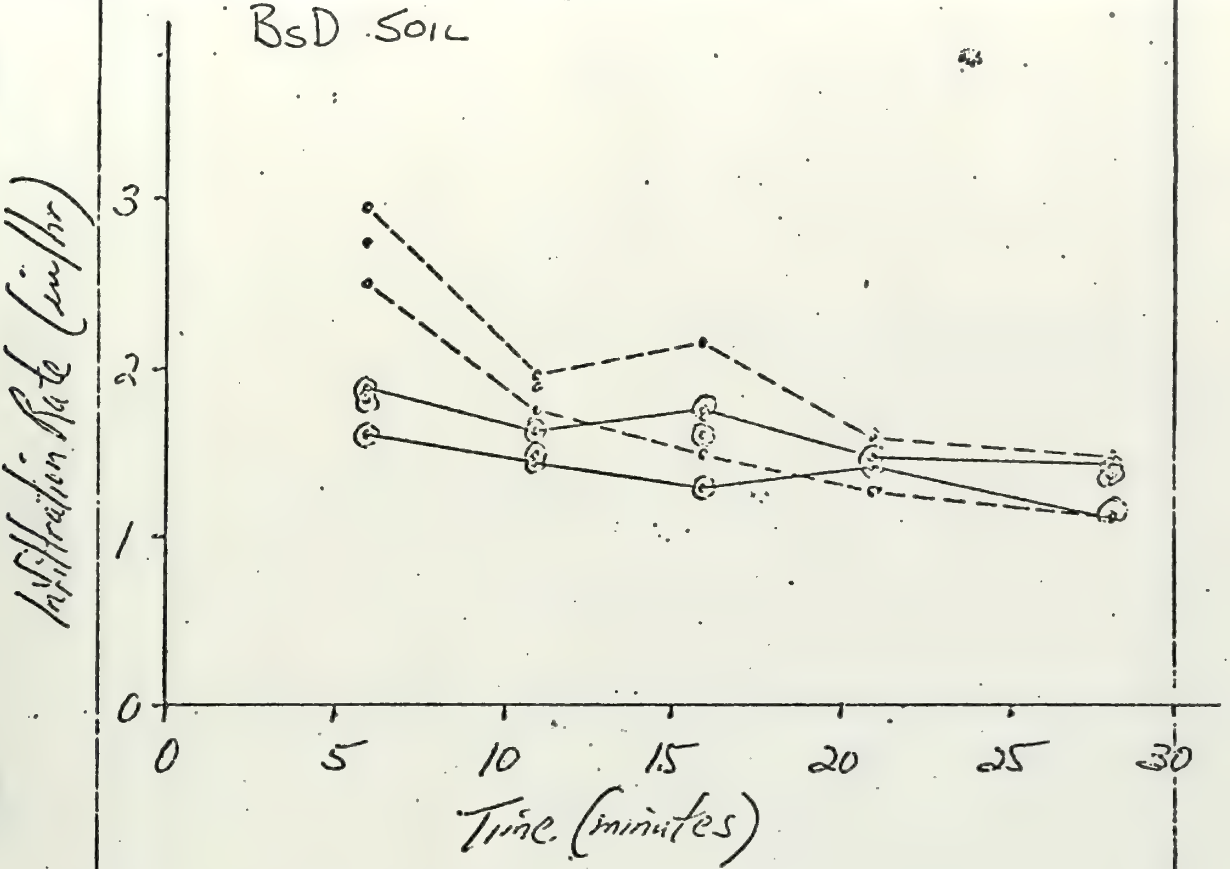
~~Figure 2~~ (Plots 4,5,6 wet; 4,5,6 dry)



60% Slope (Rocky)
Vegetation: Stipa
Blacksage
Antecedent Moisture: ——— Wet
- - - - - - Dry

Average Percent Bare Soil: 12%
Sediment Yields: Dry $\bar{x}$ = 0.46 tons/acre
Wet $\bar{x}$ = 1.06 tons/acre

~~Figure 3~~ (Plots 7,8,9 wet; 7,8,9 dry)



20-30% Slope

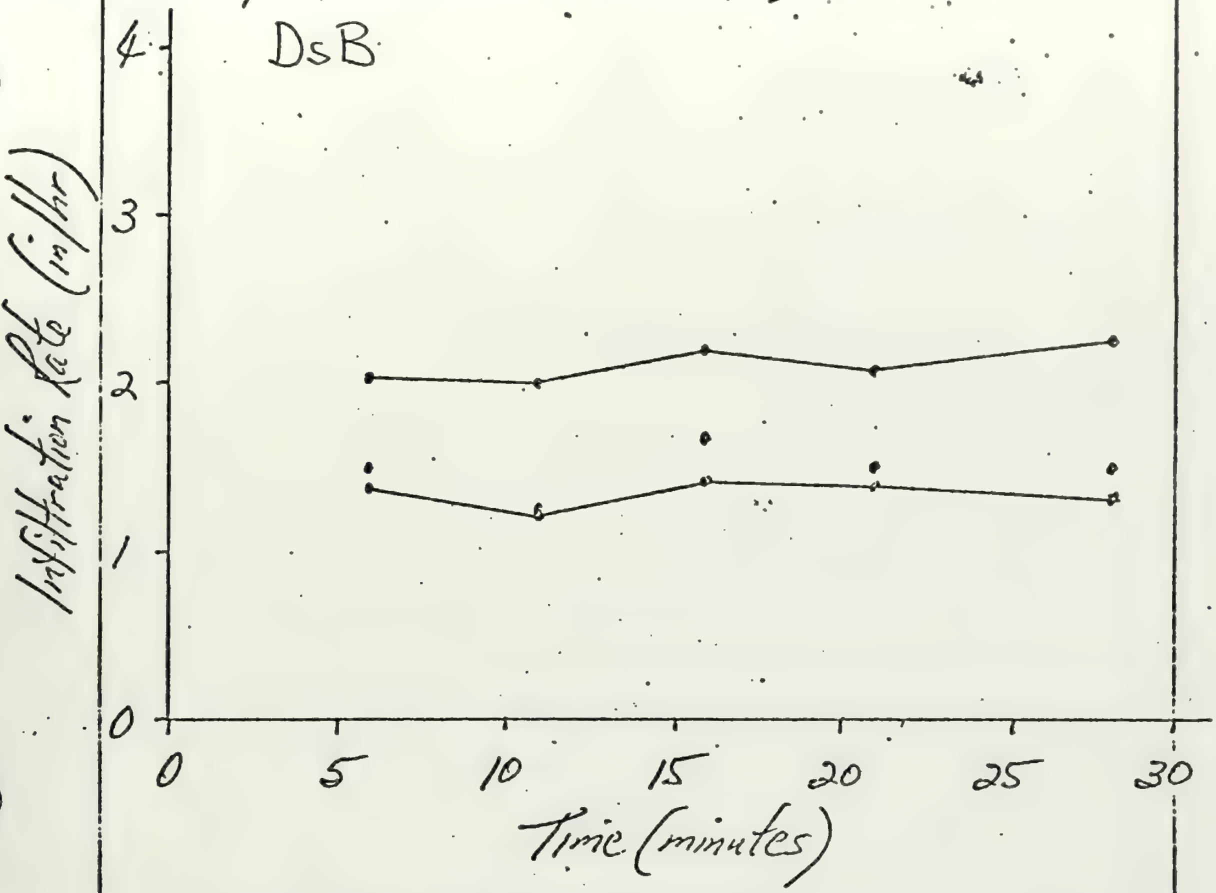
Vegetation: Greasewood
Shadscale
Blacksage
Stipa
Indian Rice Grass

Antecedent Moisture: —— Wet
- - - Dry

Average Percent Bare Soil: 16%

Sediment Yields: Dry $\bar{x}$ = 0.20 tons/acre
Wet $\bar{x}$ = 0.50 tons/acre

~~Figure 4~~ (Plots 10,11,12 wet)



15% Slope (Alluvial fan)

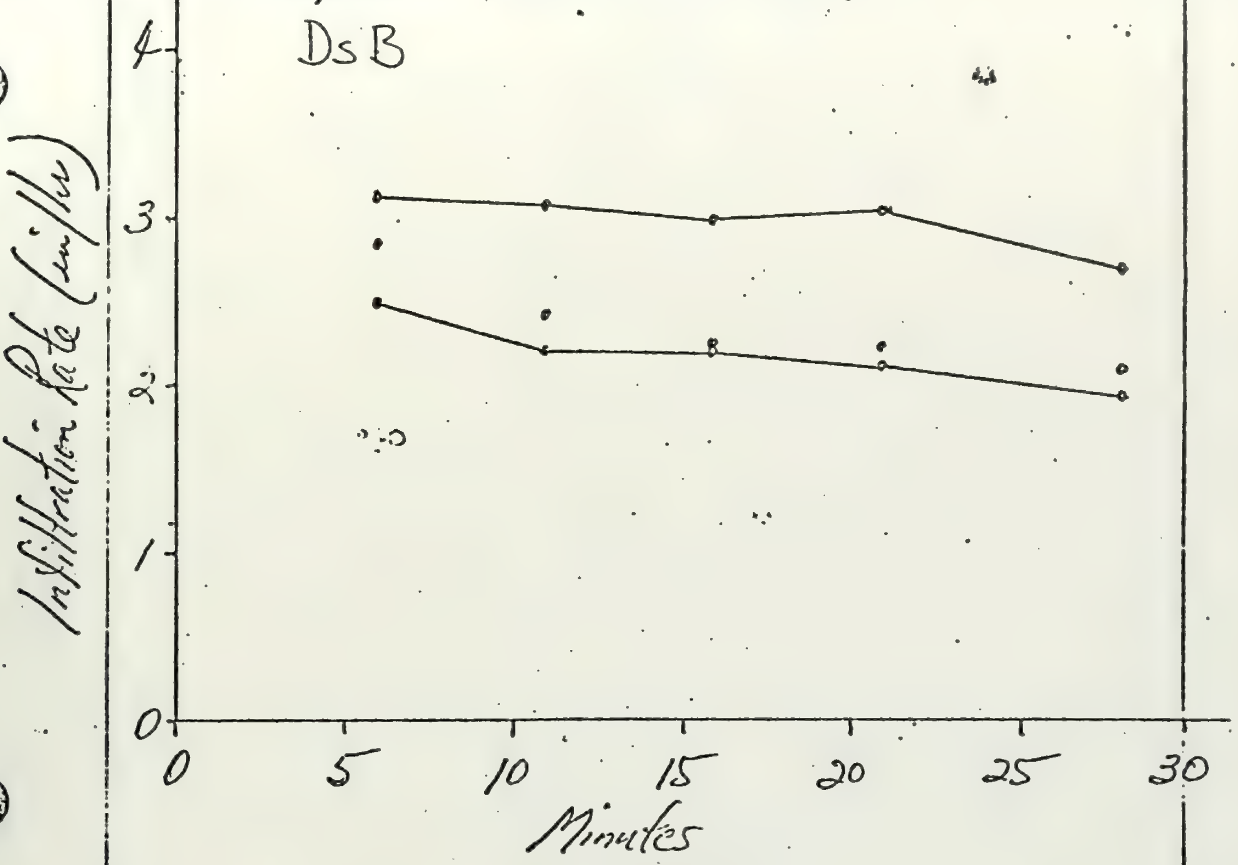
Vegetation; Blacksage
Greasewood
Tetrademia
Indian Rice Grass

Antecedent Moisture (Wet)

Average Percent Bare Soil; 21%

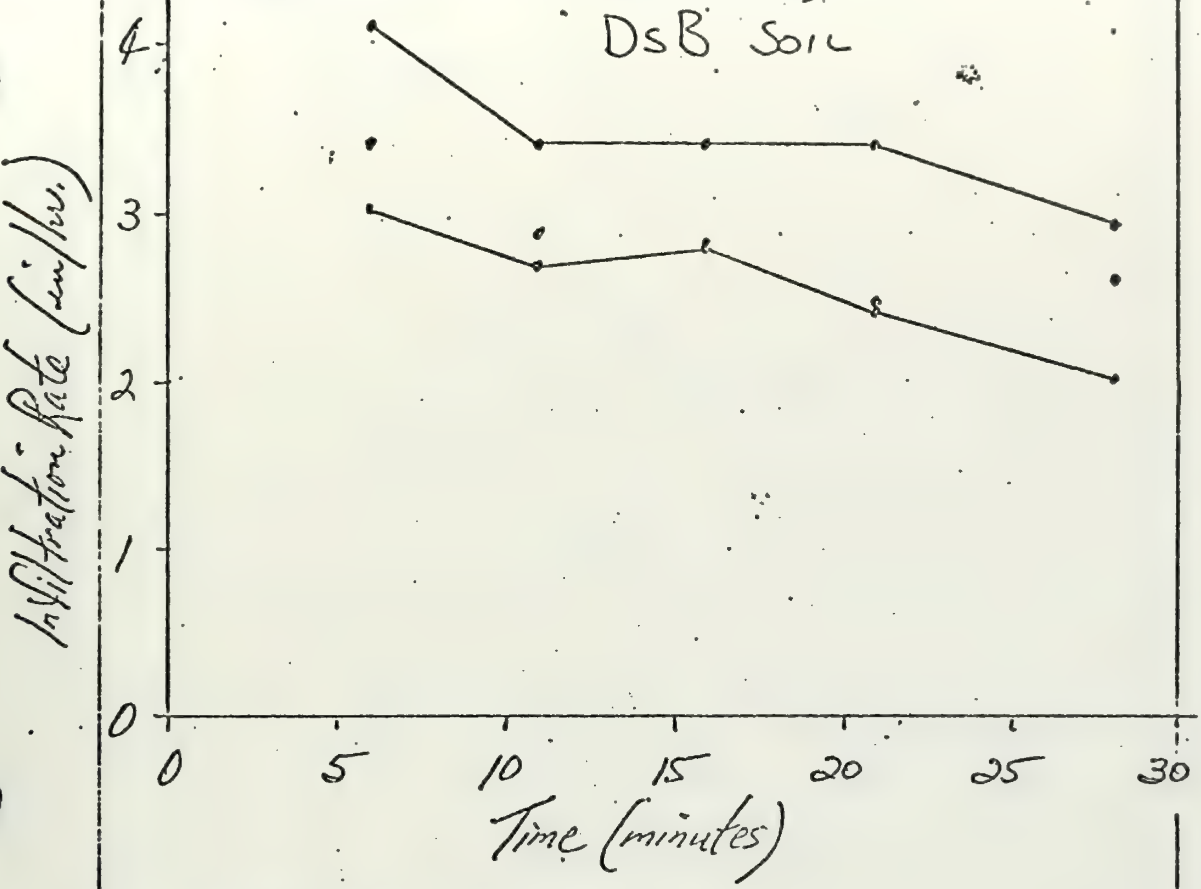
Sediment Yield: Wet $\bar{x}$ = 0.59 tons/acre

~~Figure 5~~ (Plots 13, 14, 15 wet)



15% Slope (Alluvial fan)
Vegetation: Blacksage
Greasewood
Tetrademia
Indian Rice Grass
Antecedent Moisture (Wet)
Average Percent Bare Soil: 19%
Sediment Yield: Wet $\bar{x} = 0.29$ tons/acre

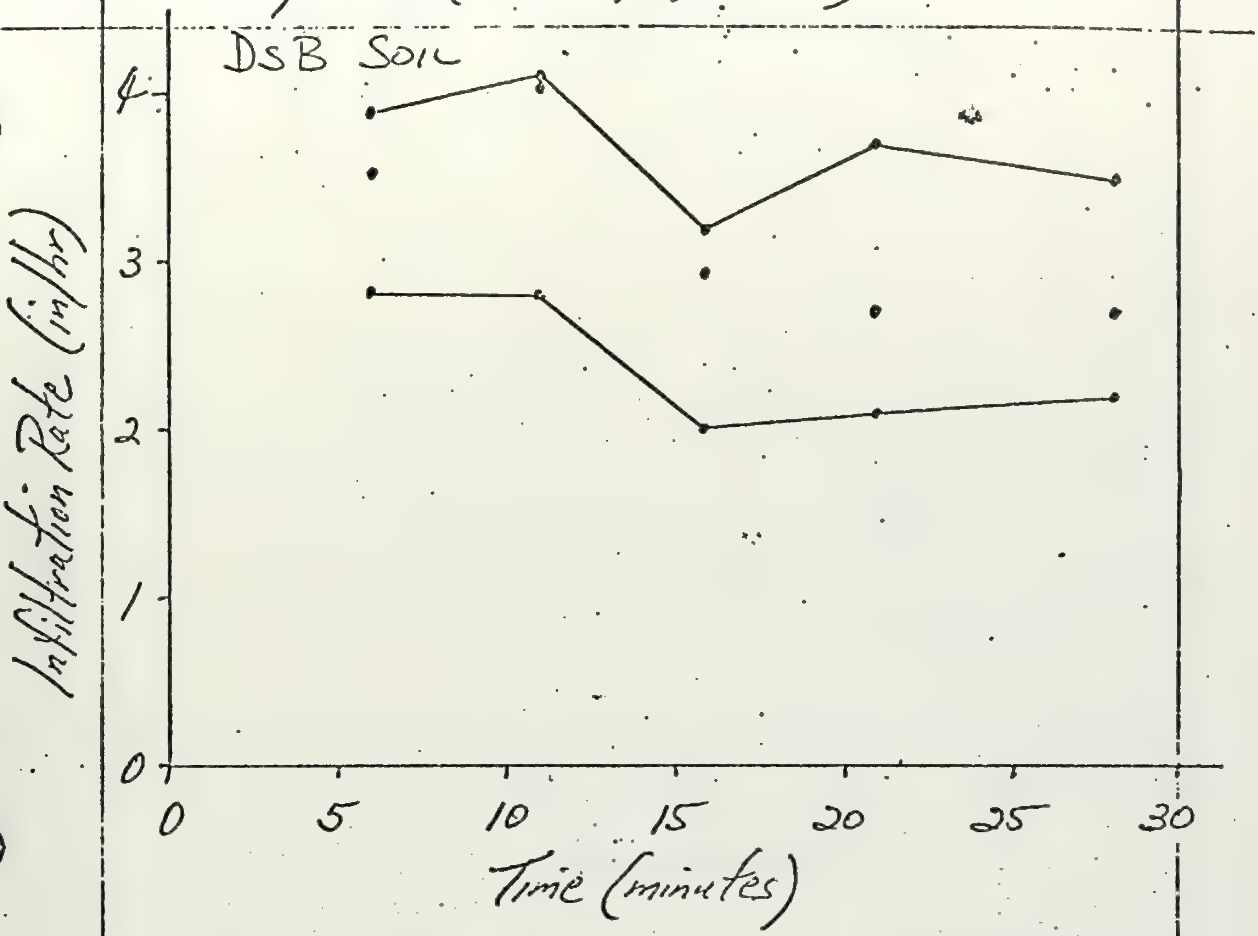
(Plots 16, 17, 18 wet)



0-5% Slope (Alluvial slope)
Vegetation: Greasewood
Sagebrush
Cheatgrass
Indian Rice Grass

Antecedent Moisture (Wet)
Average Percent Bare Soil: 30%
Sediment Yield: Wet $\bar{x} = < .01$ tons/acre

~~Figure 7~~ (Plots 19, 20, 21 wet)



0-5% Slope

Vegetation: Greasewood
Blacksage
Cheatgrass

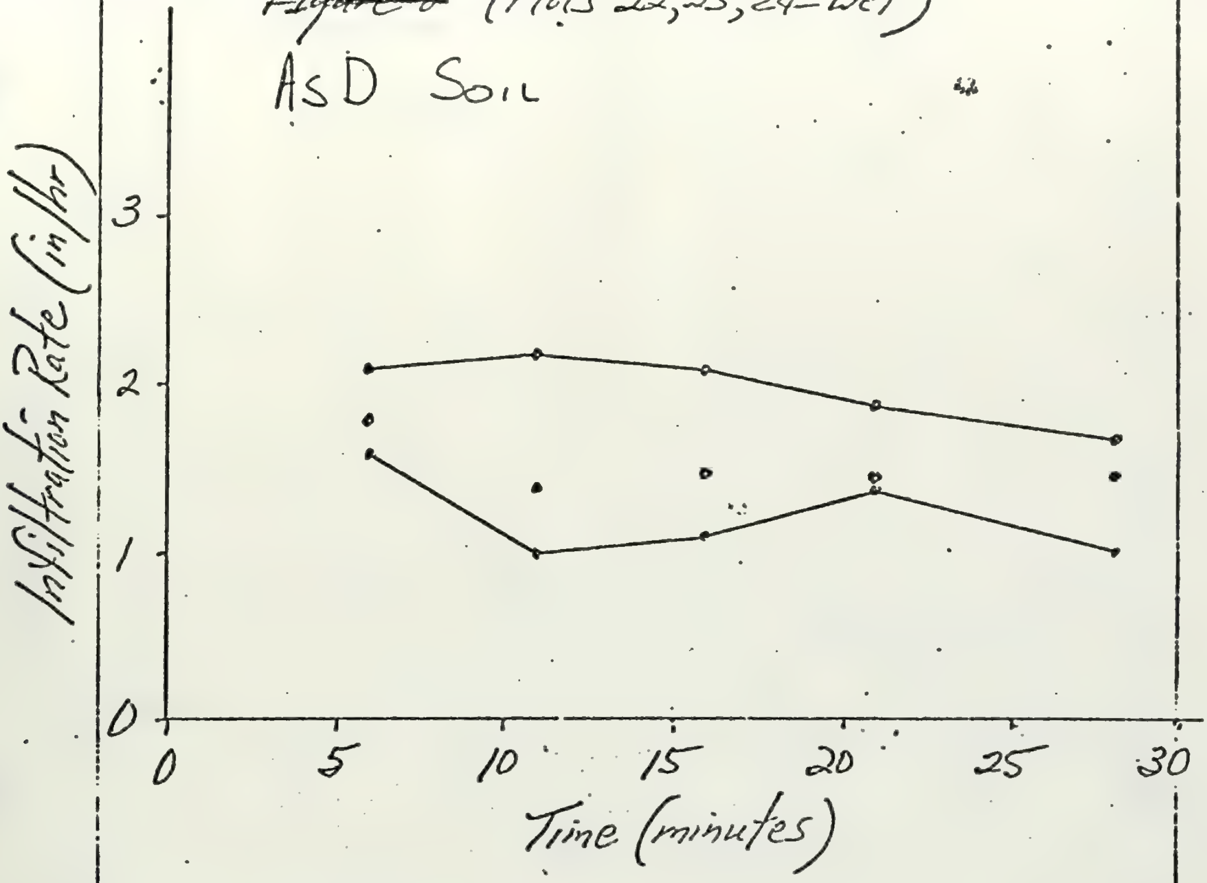
Antecedent Moisture (Wet)

Average Percent Bare Soil = 65%

Sediment Yield: Wet $\bar{x}$ = 0.18 tons/acre

~~Figure 8~~ (Plots 22,23,24-wet)

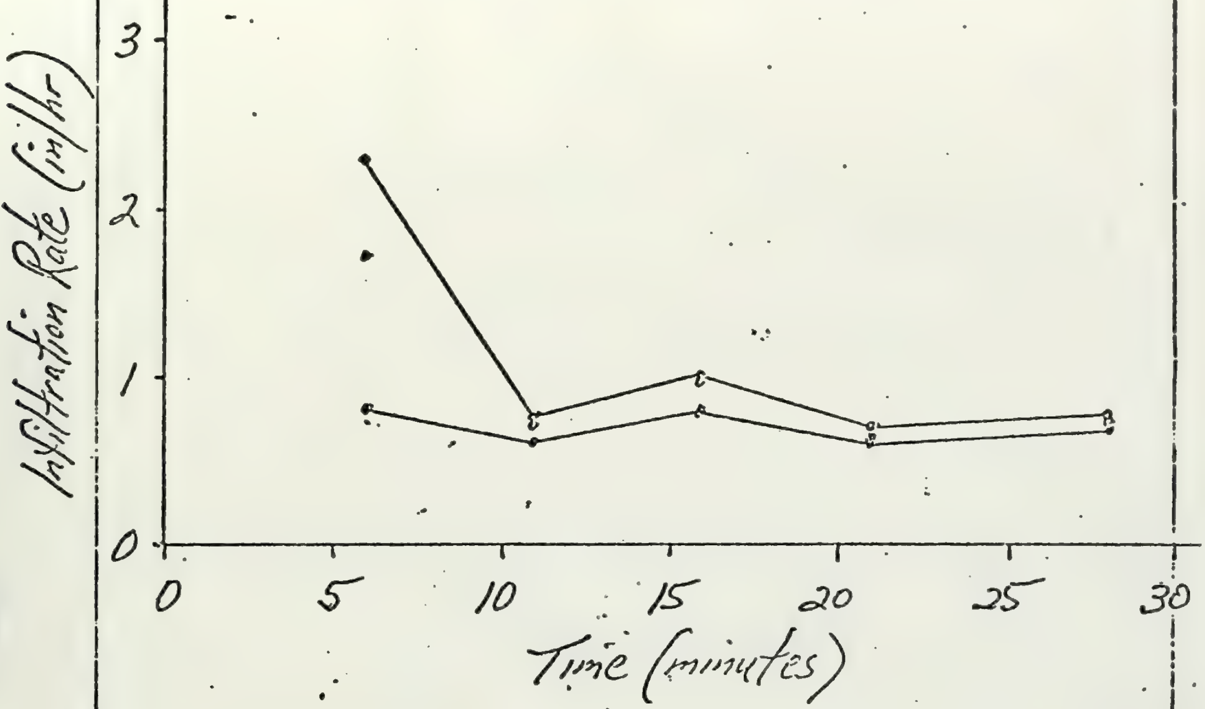
AsD Soil



30-40% Slope (Rocky)
Vegetation: Juniper
Black Sage
Shadscale
Antecedent Moisture (Wet)
Average Percent Bare Soil: 60%
Sediment Yield: Wet $\bar{x}$ = 0.56 tons/acre

~~Figure 4~~ (Plots 25, 26, 27 wet)

F Soil, D slope (not a mapped unit)



30% Slope

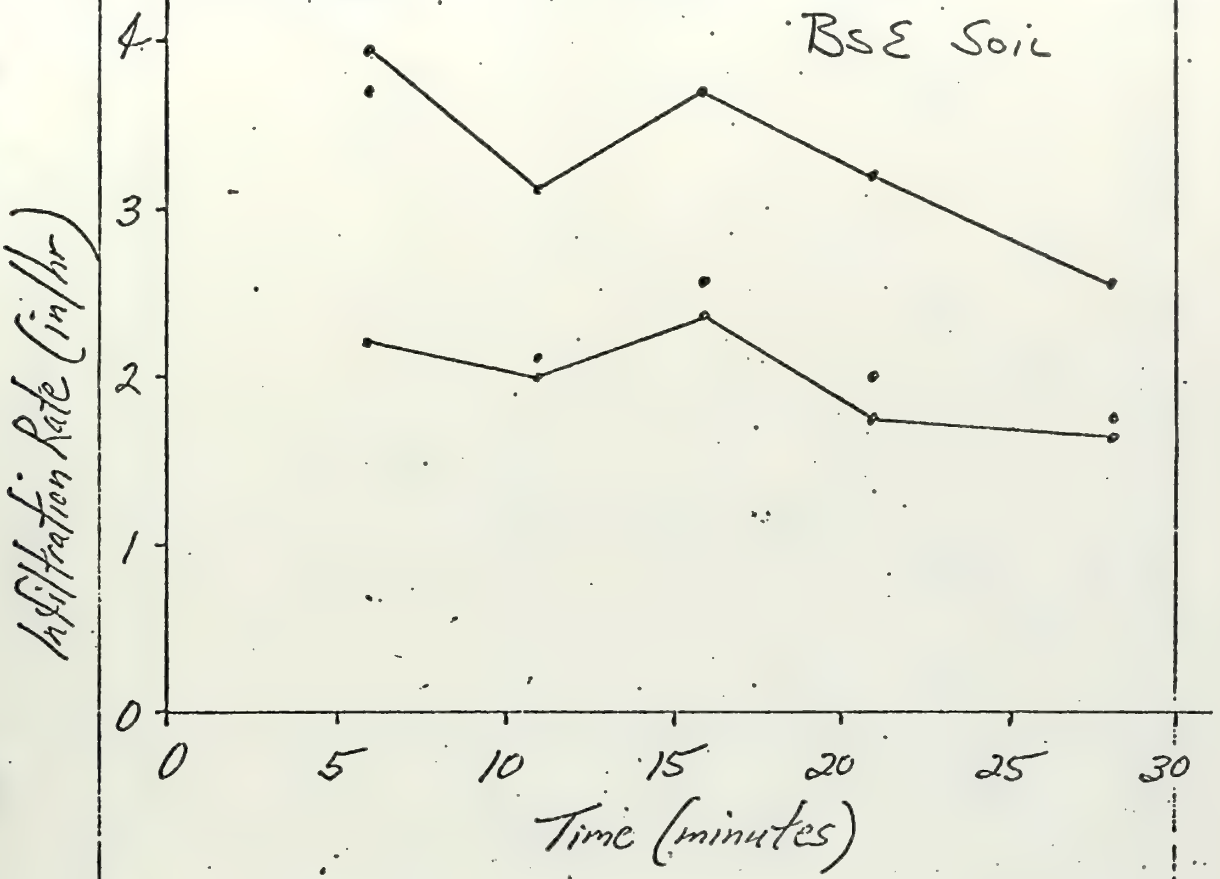
Vegetation: Juniper
Rabbitbrush
Shadscale

Antecedent Moisture (Wet)

Average Percent Bare Soil: 39%

Sediment Yield: Wet $\bar{x}$ = 0.69 tons/acre

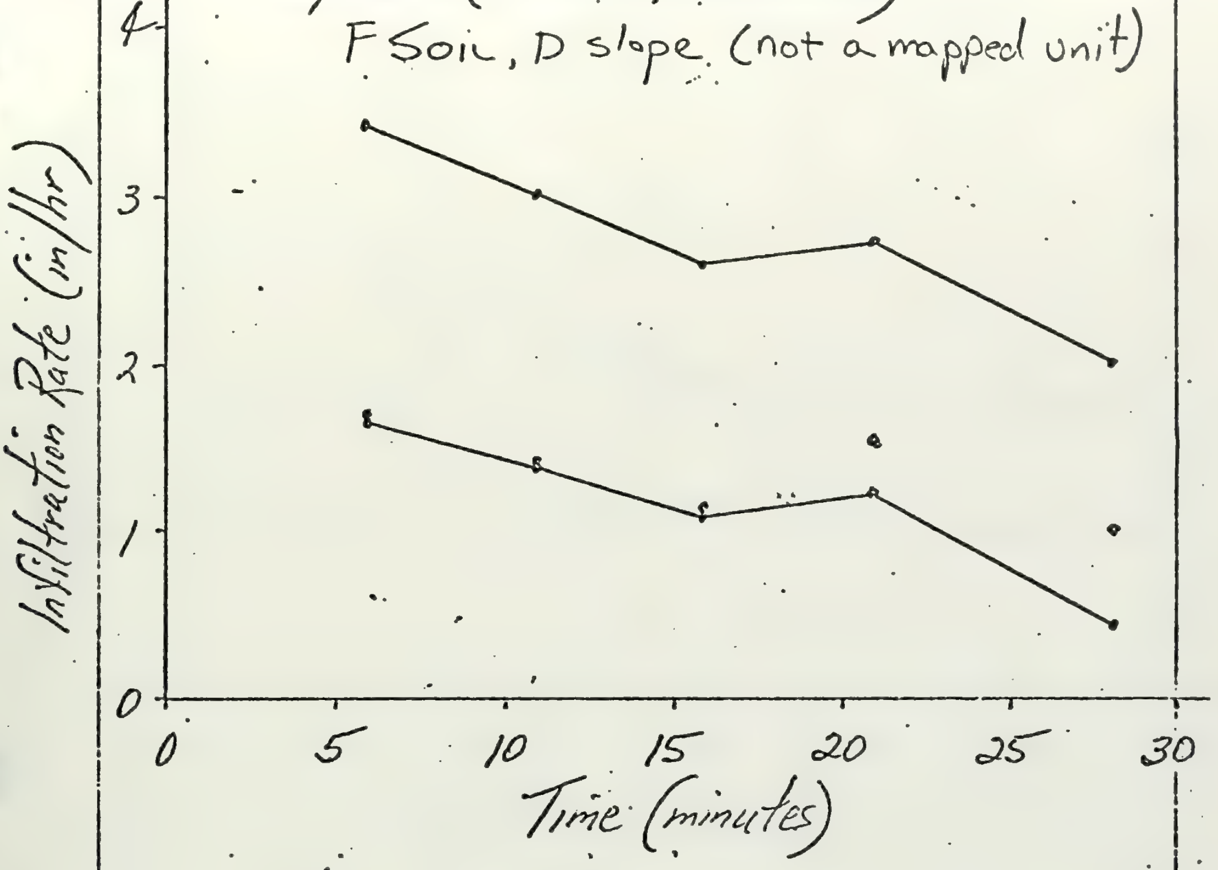
~~Figure 20~~ (Plots 28, 29, 30 wet)



80-90% Slope
Vegetation: Blacksage,
Shadscale,
Scattered Juniper
Antecedent Moisture (Wet)
Average Percent Bare Soil: 43%
Sediment Yield: Wet $\bar{x}$ = 2.44 tons/acre

~~Figure 11~~ (Plots 31,32,33 wet)

F Soil, D slope (not a mapped unit)



40% Slope (Rocky)

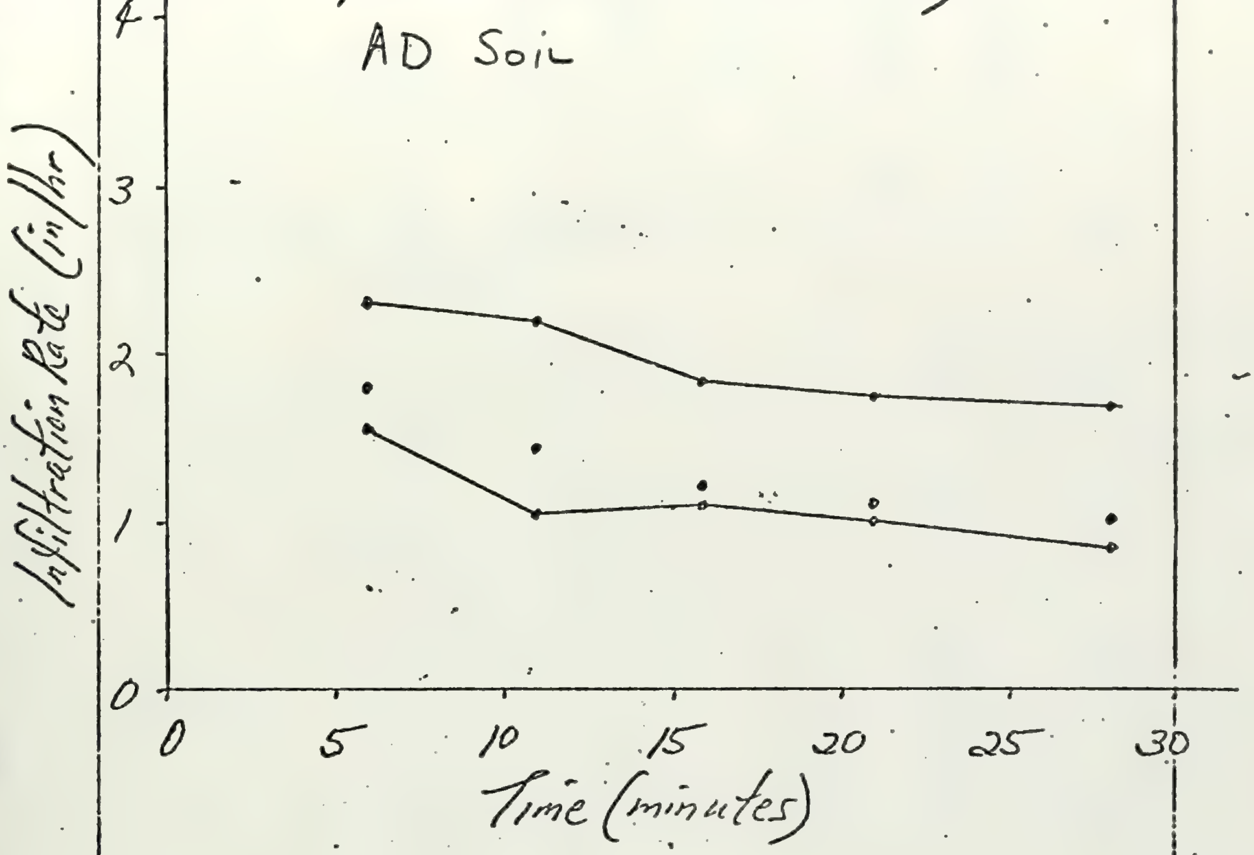
Vegetation: Shadscale
Blacksage,
Tetrademia
Cheatgrass

Antecedent Moisture (Wet)

Average Percent Bare Soil: 29%

Sediment Yield: Wet $\bar{x}$ = 0.24 tons/acre

~~Figure 72~~ (Plots 34, 35, 36 wet)



30% Slope (Rocky)

Vegetation: Blacksage
Shadscale
Tetradymia
Cheatgrass

Antecedent Moisture (wet)

Average Percent Bare Soil: 9%

Sediment Yield: Wet $\bar{x}$ = 0.61 tons/acre

below:

Plot #1 (Dry)	Time Intervals (minutes)				
	3-8	8-13	13-18	18-23	23-28
cm/hr	7.67	8.15	6.63	6.93	5.59
Infiltration Rate (in/hr)	3.02	3.21	2.61	2.73	2.18

Sediment yield = (0.20 tons per acre)
.45 gms/sq.m.

Plot #1 (Wet)	3-8	8-13	13-18	18-23	23-28
cm/hr	6.88	7.42	6.73	6.07	6.43
Infiltration Rate (in/hr)	2.71	2.92	2.65	2.39	2.53

Sediment yield = 0.25 tons per acre)
.56 gm/sq.m

	Time Intervals (minutes)				
	3-8.	8-13	13-18	18-23	23-28
Plot #2 (Dry)					
cm/hr	8.69	8.10	7.49	7.09	6.71
Infiltration Rate (in/hr)	3.42	3.19	2.95	2.79	2.64
Sediment yield =(0.15 tons per acre)					
.34 gm/sq.m.					
Plot #2 (Wet)					
cm/hr	3.38	4.95	5.18	1.73	2.72
Infiltration Rate (in/hr)	1.33	1.95	2.04	0.68	1.07
Sediment yield =(0.20 tons per acre)					
.45 gm/sq m					
Plot #3 (Dry)					
cm/hr	9.88	7.09	6.73	7.44	8.26
Infiltration Rate (in/hr)	3.89	2.79	2.95	2.93	3.25
Sediment yield =(0.01 tons per acre)					
.02 gm/sq.m.					
Plot #3 (Wet)					
cm/hr	7.44	7.34	7.77	6.93	7.29
Infiltration Rate (in/hr)	2.93	2.89	3.06	2.73	2.87
Sediment yield =(0.03 tons per acre)					
.07 gm/sq.m.					
Plot #4 (Dry)					
cm/hr	7.67	7.26	7.72	7.62	6.17
Infiltration Rate (in/hr)	3.02	2.86	3.04	3.00	2.43
Sediment yield =(0.22 tons per acre)					
.49 gm/sq.m.					
Plot #4 (Wet)					
cm/hr	6.27	5.99	5.23	6.17	5.72
Infiltration Rate (in/hr)	2.47	2.36	2.06	2.43	2.25
Sediment yield =(0.42 tons per acre)					
.94 gm/sq m					
Plot #5 (Dry)					
cm/hr	9.04	8.71	6.99	6.65	6.30
Infiltration Rate (in/hr)	3.56	3.43	2.75	2.62	2.48
Sediment yield =(0.47 tons per acre)					
1.05 gm/sq m					
Plot #5 (Wet)					
cm/hr	3.91	3.20	3.86	4.75	3.10
Infiltration Rate (in/hr)	1.54	1.26	1.52	1.87	1.22
Sediment yield =(2.35 tons per acre)					
5.27 gm/sq m					
Plot #6 (Dry)					
cm/hr	8.81	6.91	8.38	4.47	5.23
Infiltration Rate (in/hr)	3.47	2.72	3.30	1.76	2.06
Sediment yield =(0.68 tons per acre)					
1.52 gm/sq m					
Plot #6 (Wet)					
cm/hr	5.11	4.01	4.47	4.98	4.88
Infiltration Rate (in/hr)	2.01	1.58	1.76	1.96	1.92
Sediment yield =(0.42 tons per acre)					
.94 gm/sq m					

	Time Intervals (minutes)				
	3-8	8-13	13-18	18-23	23-28
Plot #7 (Dry)					
cm/hr	6.96	4.45	5.49	4.04	3.73
Infiltration rate (in/hr)	2.74	1.75	2.16	1.59	1.47
Sediment yield = (0.18 tons per acre)					
.40 gm/sq m					
Plot #7 (Wet)					
cm/hr	4.78	3.78	4.47	3.66	3.71
Infiltration Rate (in/hr)	1.88	1.49	1.76	1.44	1.46
Sediment yield = (0.38 tons per acre)					
.85 gm/sq m					
Plot #8 (Dry)					
cm/hr	6.38	4.75	4.39	3.78	3.45
Infiltration Rate (in/hr)	2.51	1.87	1.73	1.49	1.36
Sediment yield = (0.27 tons per acre)					
.61 gm/sq m					
Plot #8 (Wet)					
cm/hr	4.09	4.19	4.14	3.89	3.53
Infiltration Rate (in/hr)	1.61	1.65	1.63	1.53	1.39
Sediment yield = (0.79 tons per acre)					
1.77 gm/sq m					
Plot #9 (Dry)					
cm/hr	7.54	4.95	3.81	3.25	2.87
Infiltration Rate (in/hr)	2.97	1.95	1.50	1.28	1.13
Sediment yield = (0.16 tons per acre)					
.36 gm/sq m					
Plot #9 (Wet)					
cm/hr	4.70	3.76	3.33	3.78	2.90
Infiltration Rate (in/hr)	1.85	1.48	1.31	1.49	1.14
Sediment yield = (0.33 tons per acre)					
.74 gm/sq m					
Plot #10 (Wet)					
cm/hr	3.73	3.23	3.63	3.53	3.89
Infiltration Rate (in/hr)	1.47	1.27	1.43	1.39	1.53
Sediment yield = (0.32 tons per acre)					
.72 gm/sq m					
Plot #11 (Wet)					
cm/hr	3.53	3.20	4.29	3.84	3.43
Infiltration Rate (in/hr)	1.39	1.26	1.69	1.51	1.35
Sediment yield = (0.67 tons per acre)					
1.50 gm/sq m					
Plot #12 (Wet)					
cm/hr	5.23	5.08	5.59	5.36	5.79
Infiltration Rate (in/hr)	2.06	2.00	2.20	2.11	2.28
Sediment yield = (0.78 tons per acre)					
1.75 gm/sq m					
Plot #13 (Wet)					
cm/hr	7.19	5.59	5.74	5.72	4.93
Infiltration Rate (in/hr)	2.83	2.20	2.26	2.25	1.94
Sediment yield = (0.34 tons per acre)					
.76 gm/sq m					

	Time Intervals (minutes)				
	3-8	8-13	13-18	18-23	23-28
Plot #14 (Wet)					
cm/hr	7.98	7.85	7.54	7.75	6.88
Infiltration Rate (in/hr)	3.14	3.09	2.97	3.05	2.71
Sediment yield = (0.25 tons per acre)					
.56 gm/sq m					
Plot #15 (Wet)					
cm/hr	6.32	6.15	5.59	5.38	5.26
Infiltration Rate (in/hr)	2.49	2.42	2.20	2.12	2.07
Sediment yield = (0.28 tons per acre)					
.63 gm/sq m					
Plot #16 (Wet)					
cm/hr	7.75	7.34	7.09	6.10	6.60
Infiltration Rate (in/hr)	3.05	2.89	2.79	2.40	2.60
Sediment yield = (0.01 tons per acre)					
.02 gm/sq m					
Plot #17 (Wet)					
cm/hr	10.39	8.69	8.59	8.69	7.44
Infiltration Rate (in/hr)	4.09	3.42	3.38	3.42	2.93
Sediment yield = (0.00 tons per acre)					
.00 gm/sq m					
Plot #18 (Wet)					
cm/hr	8.69	6.81	7.14	6.20	5.11
Infiltration Rate (in/hr)	3.42	2.68	2.81	2.44	2.01
Sediment yield = (0.00 tons per acre)					
.00 gm/sq m					
Plot #19 (Wet)					
cm/hr	8.99	10.49	7.39	6.88	6.81
Infiltration Rate (in/hr)	3.54	4.13	2.91	2.71	2.68
Sediment yield = (0.09 tons per acre)					
.20 gm/sq m					
Plot #20 (Wet)					
cm/hr	9.86	10.29	8.18	9.45	8.94
Infiltration Rate (in/hr)	3.88	4.05	3.22	3.72	3.52
Sediment yield = (0.17 tons per acre)					
.38 gm/sq m					
Plot #21 (Wet)					
cm/hr	7.16	7.11	5.11	538	5.64
Infiltration Rate (in/hr)	2.82	2.80	2.01	2.12	2.22
Sediment yield = (0.28 tons per acre)					
.63 gm/sq m					
Plot #22 (Wet)					
cm/hr	4.09	2.49	2.87	3.58	2.49
Infiltration Rate (in/hr)	1.61	0.98	1.13	1.41	0.98
Sediment yield = (0.86 tons per acre)					
1.93 gm/sq m					
Plot #23 (Wet)					
cm/hr	4.52	3.51	3.89	3.68	3.73
Infiltration Rate (in/hr)	1.78	1.38	1.53	1.45	1.47
Sediment yield = (0.59 tons per acre)					
1.32 gm/sq m					

	Time Intervals (minutes)				
	3-8	8-13	13-18	18-23	23-28
Plot #24 (Wet)					
cm/hr	5.38	5.59	5.36	4.90	4.37
Infiltration Rate (in/hr)	2.12	2.20	2.11	1.93	1.72
Sediment yield = 0.23 tons per acre					
.52 gm/sq m					
Plot #25 (Wet)					
cm/hr	2.08	1.52	2.08	1.50	1.83
Infiltration Rate (in/hr)	0.82	0.60	0.82	0.59	0.72
Sediment yield = 0.69 tons per acre					
1.55 gm/sq m					
Plot #26 (Wet)					
cm/hr	5.87	1.91	2.57	1.83	1.88
Infiltration Rate (in/hr)	2.31	0.75	1.01	0.72	0.74
Sediment yield = 0.80 tons per acre					
1.79 gm/sq m					
Plot #27 (Wet)					
cm/hr	4.42	1.91	2.57	1.57	1.88
Infiltration Rate (in/hr)	1.74	0.75	1.01	.62	.74
Sediment yield = 0.57 tons/acre					
1.28 gm/sq m					
Plot #28 (Wet)					
cm/hr	9.35	7.98	9.35	8.71	6.50
Infiltration Rate (in/hr)	3.68	3.14	3.68	3.43	2.56
Sediment yield = 0.59 tons per acre					
1.32 gm/sq m					
Plot #29 (Wet)					
cm/hr	5.56	5.31	5.97	4.47	4.55
Infiltration Rate (in/hr)	2.19	2.09	2.35	1.76	1.79
Sediment yield = 4.72 tons per acre					
10.58 gm/sq m					
Plot #30 (Wet)					
cm/hr	10.06	5.03	6.30	5.11	4.19
Infiltration Rate (in/hr)	3.96	1.98	2.48	2.01	1.65
Sediment yield = 2.02 tons per acre					
4.53 gm/sq m					
Plot #31 (Wet)					
cm/hr	4.32	3.66	2.77	3.20	2.54
Infiltration Rate (in/hr)	1.70	1.44	1.09	1.26	1.00
Sediment yield = 0.03 tons per acre					
.07 gm/sq m					
Plot #32 (Wet)					
cm/hr	8.66	7.72	6.58	6.96	5.28
Infiltration Rate (in/hr)	3.41	3.04	2.59	2.74	2.08
Sediment yield = 0.17 tons per acre					
.38 gm/sq m					
Plot #33 (Wet					
cm/hr	4.14	3.48	2.79	3.91	1.09
Infiltration Rate (in/hr)	1.63	1.37	1.10	1.54	0.43
Sediment yield = 0.51 tons per acre					
1.14 gm/sq m					

	Time Intervals (minutes) 3-8	8-13	13-18	18-23	23-28
Plot #34 (Wet)					
cm/hr	5.92	5,59	4.70	4,45	4.37
Infiltration Rates (in/hr)	2.33	2.20	1.85	1.75	1.72
Sediment yield = (0.26 tons per acre) .58 gm/sq m					
Plot #35 (Wet)					
cm/hr	3.94	2.77	2,79	2,49	2.16
Infiltration Rate (in/hr)	1.55	1.09	1.10	0.98	0.85
Sediment yield = (1.14 tons per acre) 2.55 gm/sq m					
Plot #36 (Wet)					
cm/hr	4.55	3.68	3.10	2,84	2,62
Infiltration Rate (in/hr)	1.79	1.45	1.22	1.12	1.03
Sediment yield = (0.43 tons per acre) .96 gm/sq m					

REPORT OF ANALYSIS

CUSTOMER AEROVIRONMENT INC.
ATTENTION Dr. Ivar Tombach, Director of Environmental Programs
ADDRESS 145 Vista Avenue
CITY Pasadena, California 91107
S.O. NO. 3051

TYPE OF ANALYSIS DETERMINATION OF GAMMA ISOTOPIC by GeLi in SOIL SAMPLES
CUSTOMER ORDER NUMBER 45327
SAMPLES RECEIVED 12-19-74

Identification:	#39 0-4	#39 17-35	#40 0-6	#40 31-137
Dry Weight (g):	2728	2546	2542	2960

Nuclide Observed	pCi/g (Dry)			
K-40	18 ± 2	11 ± 3	20 ± 3	16 ± 2
Bi-214	0.73 ± 0.29	0.49 ± 0.29	0.79 ± 0.36	0.85 ± 0.31
Tl-208	0.36 ± 0.11	0.19 ± 0.11	0.30 ± 0.12	0.30 ± 0.12
Pb-214	0.65 ± 0.27	0.71 ± 0.24	0.78 ± 0.30	0.74 ± 0.27
Ac-228	0.92 ± 0.52	0.79 ± 0.50	< 0.68	0.94 ± 0.50
Pb-212	1.5 ± 0.3	1.2 ± 0.3	1.0 ± 0.3	1.0 ± 0.3
Cs-137	0.98 ± 0.14	< 0.12	1.6 ± 0.2	0.09 ± 0.08

PE OF ANALYSIS DETERMINATION of RADIUM-226 & STRONTIUM-90 in SOIL SAMPLES

Sample Identification	Total Dry Weight (g)	pCi/g (Dry) Ra-226	pCi/g (Dry) Sr-90
#39 0-4	2728	0.17 ± 0.01	0.52 ± 0.02
#39 17-35	2545	0.66 ± 0.03	0.00 ± 0.01
#40 0-6	2542	0.87 ± 0.03	0.48 ± 0.02
#40 31-137	2959	0.66 ± 0.03	0.02 ± 0.01

☐ REPORTED VIA TELEPHONE
☐ REPORTED VIA TWX

PAGE 1 OF 1 PAGE

EBERLINE INSTRUMENT
CORPORATION
P.O. BOX 3874 ALBUQUERQUE, NEW MEXICO 87110
PHONE (505) [illegible]

APPROVED BY Ernest A. Sanchez
Ernest A. Sanchez, Manager
Albuquerque Laboratory
DAT: 03-13-75

B. TERRESTRIAL VERTEBRATES

1. RESULTS OF FLUSHING TRANSECT SAMPLING

on or within 1.6 km (1 mile) of Utah Oil Shale Tracts, October 1975. X = herptile observed. G = greasewood, J = juniper, S = shadscale, R = riparian.

October 1975

REPTILE (ORDER / SPECIES)	VEGETATION TYPE			
	G	J	S	R
Squamata				
Eastern Fence Lizard	–	X	–	X
Sagebrush Lizard	X	X	X	–
Short-horned Lizard	–	–	X	–
Tree Lizard	–	X	–	–
Side-blotched Lizard	X	X	X	X
Western Whiptail	–	X	–	–
Striped Whipsnake	–	X	X	–
Gopher Snake	X	X	–	X
Western Terrestrial Garter Snake	–	–	–	X
Western Rattlesnake	X	–	–	–

on or within 1.6 km (1 mile) of Utah Oil Shale Tracts, October 1975. X = bird observed. G = greasewood, J = juniper, S = shadscale, R = riparian.

BIRD (ORDER/SPECIES)	October 1975			
	VEGETATION TYPE			
	G	J	S	R
Falconiformes				
Marsh Hawk	X	–	X	–
Cooper's Hawk	–	–	–	X
Red-tailed Hawk	X	–	X	–
Golden Eagle	X	X	X	–
Prairie Falcon	X	X	X	X
American Kestrel	X	X	X	–
Gruiformes				
Sandhill Crane	–	–	–	X
Columbiformes				
Mourning Dove	X	X	X	X
Strigiformes				
Great Horned Owl	–	–	–	X
Coraciiformes				
Belted Kingfisher	–	–	–	X
Piciformes				
Downy Woodpecker	–	–	–	X
Yellow-bellied Sapsucker	–	–	–	X
Common Flicker	–	X	–	X
Passeriformes				
Horned Lark	X	X	X	X
Barn Swallow	–	–	X	–
Black-billed Magpie	X	X	X	X
Common Raven	–	–	X	–
Clark's Nutcracker	–	X	–	–
Pinyon Jay	X	X	–	–
Plain Titmouse	X	X	–	–
Black-capped Chickadee	–	–	–	X
Common Bushtit	–	?	–	X
Rock Wren	X	X	X	–

ABLE 2 (CONTINUED).
(Page 2)

BIRD (ORDER / SPECIES)	October 1975 VEGETATION TYPE G	J	S	R
Passeriformes (CONTINUED)				
Sage Thrasher	X	-	X	-
Townsend's Solitaire	-	-	-	X
Swainson's Thrush	-	-	-	X
American Robin	-	-	-	X
Mountain Bluebird	X	X	X	-
Ruby-crowned Kinglet	-	X	-	X
Loggerhead Shrike	X	-	X	-
Western Meadowlark	X	-	X	X
Brewer's Blackbird	-	-	-	X
House Finch	-	X	-	-
Pine Siskin	-	-	-	X
Lark Sparrow	X	X	-	-
White-crowned Sparrow	X	X	-	X
Tree Sparrow	-	-	-	X
Chipping Sparrow	X	X	-	X
Dark-eyed Junco	X	X	-	X
Sage Sparrow	X	X	X	X
Song Sparrow	-	-	-	X
Rufous-sided Towhee	X	-	-	X

observations on or within 1.6 km (1 mile) of Utah Oil Shale Tracts, October 1975. X = Mammal observed. G = greasewood, J = juniper, S = shadscale, R = riparian.

MAMMAL (ORDER/SPECIES)	October 1975 VEGETATION TYPE			
	G	J	S	R
Chiroptera				
Bat (unidentified species)	X	X	-	-
Carnivora				
Badger	-	-	-	X
Coyote	-	X	-	X
Rodentia				
Whitetail Antelope Squirrel	X	-	X	-
Golden-mantled Squirrel	X	X	X	X
Colorado Chipmunk	-	X	-	X
Whitetail Prairie Dog	-	-	X	-
Apache Pocket Mouse	X	X	-	X
Ord Kangaroo Rat	X	-	-	-
Deer Mouse	X	X	-	X
Pinyon Mouse	-	X	-	-
Desert Woodrat	X	X	-	-
Porcupine	-	X	-	X
Lagomorpha				
Desert Cottontail	X	X	X	X
Artiodactyla				
Mule Deer	X	X	X	X
Domestic Cattle	-	-	-	X

Page 1)	TABLE 4. [See title opposite]	DISTANCE (m)							NO. SAMPLES	DENSITY			
										NUMBER		BIOMASS (kg)	
AMPLING SITE*	HERPTILE (SPECIES)	0	1	2	3	4	5	75		OBSERVED	PER HA	OBSERVED	PER HA
PG transect only)	(NONE)								0	0			
SG transects only)	Sagebrush Lizard	2							2	2			
	Side-blotched Lizard	2							2	2			
OG	Sagebrush Lizard	3							3	3			
	Side-blotched Lizard	3							3	3			
PJ transects only)	Eastern Fence Lizard	3							3	3			
	Sagebrush Lizard	4							4	4			
	Tree Lizard	1							1	1			
	Side-blotched Lizard	5							5	5			
	Western Whiptail	1							1	1			
	Unidentified, lizard	2	1						3	3			
SJ	Sagebrush Lizard	3							3	3			
	Side-blotched Lizard	3							3	3			
OJ 4 transects only)	Sagebrush Lizard	2							2	2			
	Side-blotched Lizard	2	1				1		4	4			
PR transects only)	Side-blotched Lizard				1				1	1			
OR transects only)	Eastern Fence Lizard	1							1	1			
	Side-blotched Lizard	1							1	1			

TABLE . Herptile numbers, estimated wet weight biomass, and distance from transe line on sampling sites during October 197 sampling period. PG = primary greasewood, SG = secondary greasewood, OG = off-tract greasewoo PJ = primary juniper, SJ = secondary juniper OJ = off-tract juniper, PR = primary ripari OR = off-tract riparian.

* No transects were walked on the followi sampling sites due to inclement weather primary shadscale, secondary shadscale, off-tract shadscale, riparian greasewood

Page 1) TABLE 5. [See title opposite]

SAMPLING SITE	BIRD (SPECIES)	DISTANCE (m) 0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100	NO. SAMPLES	DENSITY NUMBER OBSERVED	DENSITY NUMBER PER HA	DENSITY BIOMASS (kg) OBSERVED	DENSITY BIOMASS (kg) PER HA
PG	American Kestrel	1											1	1			
	Black-billed Magpie	1						1		2			4	4			
	Pinyon Jay	96		3									5	99			
	Plain Titmouse					1		1					2	2			
	White-crowned Sparrow			2									1	2			
	Dark-eyed Junco	2		2									2	4			
	Sage Sparrow			1									1	1			
SG	Golden Eagle											1	1	1			
	Horned Lark	9								6			2	15			
	Black-billed Magpie											1	1	1			
	Rock Wren				1	1		4					4	6			
	Mountain Bluebird				1								1	1			
	Western Meadowlark							1					1	1			
	Sage Sparrow			2	1			2					3	5			
	Unidentified, Passeriformes	1											1	1			
OG	Golden Eagle	1									1		2	2			
	Horned Lark			5									1	5			
	Lark Sparrow	5											1	5			
	Chipping Sparrow					1							1	1			
	Sage Sparrow	1	1			1							3	3			
	Rufous-sided Towhee						1						1	1			
	Unidentified, Fringillidae	2											1	2			

TABLE . Bird numbers, estimated wet weight bioma and distance from transect on sampling sites during October 1975 sampling peri

PG = primary greasewood,
SG = secondary greasewood,
OG = off-tract greasewood,
PJ = primary juniper,
SJ = secondary juniper,
OJ = off-tract juniper,
PS = primary shadscale,
SS = secondary shadscale,
OS = off-tract shadscale,
PR = primary riparian,
OR = off-tract riparian,
RG = riparian greasewood.

age 2) TABLE 5 (CONTINUED).

MPLING SITE	BIRD (SPECIES)	DISTANCE (m) 0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100	NO. SAMPLES	DENSITY NUMBER OBSERVED	NUMBER PER HA	BIOMASS (kg) OBSERVED	BIOMASS (kg) PER HA
PJ	Horned Lark	3											1	3			
	Black-billed Magpie						1	1					2	2			
	Clark's Nutcracker	6											1	6			
	Pinyon Jay	1	9		2				4	1			5	17			
	Plain Titmouse		1										1	1			
	Rock Wren				2				1				2	3			
	Mountain Bluebird	2								1			3	3			
	House Finch	1											1	1			
	Dark-eyed Junco	2											1	2			
	Unidentified, Passeriformes	2											2	2			
SJ	Mountain Bluebird	5		3									2	8			
	Lark Sparrow			1									1	1			
	Chipping Sparrow					3							1	3			
	Unidentified, Fringillidae	1											1	1			
CJ	Pinyon Jay			4		10							2	14			
	Plain Titmouse		1	1									2	2			
	Chipping Sparrow					1							1	1			
	Dark-eyed Junco						2						1	2			
	Sage Sparrow	1											1	1			
	Unidentified, Fringillidae	3											1	3			
PS	Marsh Hawk											1	1	1			
	Horned Lark	61											4	61			
	Barn Swallow	4											1	4			
	Rock Wren	1											1	1			
	Loggerhead Shrike						1						1	1			

age 3) TABLE 5 (CONTINUED).

MPLING SITE	BIRD (SPECIES)	DISTANCE (m) 0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100	NO. SAMPLES	DENSITY NUMBER OBSERVED	PER HA	BIOMASS(kg) OBSERVED	PER HA
SS	Horned Lark	24											3	24			
	Western Meadowlark	1	1					2		3			5	7			
	Sage Sparrow	1	2										3	3			
CS	Horned Lark	29											3	29			
	Loggerhead Shrike					1							1	1			
	Western Meadowlark			2									2	2			
	Sage Sparrow	4	2										3	6			
PR	Cooper's Hawk	1						1					2	2			
	Great Horned Owl						1						1	1			
	Downy Woodpecker						1						1	1			
	Yellow-bellied Sapsucker						1						1	1			
	Common Flicker			2									2	2			
	Horned Lark	22											1	22			
	Black-billed Magpie	4					1						5	5			
	Townsend's Solitaire		1										1	1			
	American Robin	1											1	1			
	Ruby-crowned Kinglet	1											1	1			
	Brewer's Blackbird	1											1	1			
	Dark-eyed Junco	5											1	5			
	Rufous-sided Towhee	5		1									3	6			
	Unidentified, Fringillidae	1	1										2	2			
	Unidentified, Passeriformes	2	1						1				4	4			

age 4)

TABLE 5 (CONTINUED).

AMPLING SITE	BIRD (SPECIES)	DISTANCE (m)											NO. SAMPLES	DENSITY			
														NUMBER		BIOMASS (kg)	
		0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100		OBSERVED	PER HA	OBSERVED	PER HA
OR	Mourning Dove	1		2	1		1						5	5			
	Downy Woodpecker	1											1	1			
	Yellow-bellied Sapsucker		2	3	1	1							7	7			
	Common Flicker					1	1						2	2			
	Black-billed Magpie	3							1				3	4			
	Swainson's Thrush		1										1	1			
	White-crowned Sparrow	2											2	2			
	Chipping Sparrow	1											1	1			
	Dark-eyed Junco				1								1	1			
	Rufous-sided Towhee	1	2				1						4	4			
	Unidentified, Fringillidae	2	1		1								3	4			
	Unidentified, Passeriformes	2											2	2			
RG	Common Flicker					1	1						2	2			
	Common Bushtit	7	9										2	16			
	Townsend's Solitaire			3									1	3			
	Pine Siskin		1										1	1			
	White-crowned Sparrow	3		2									4	5			
	Tree Sparrow	1											1	1			
	Chipping Sparrow	1	1										2	2			
	Dark-eyed Junco	28	10	4									8	42			
	Sage Sparrow	4	2	2									5	8			
	Rufous-sided Towhee		1										1	1			
	Unidentified, Passeriformes	10											1	10			

ge 1)

TABLE 6. [See title opposite]

AMPLING SITE	MAMMAL (SPECIES)	DISTANCE (m) 0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100	NO. SAMPLES	DENSITY NUMBER OBSERVED	PER HA	BIOMASS (kg) OBSERVED	PER HA
PG	Desert Cottontail					1							1	1			
SG	Whitetail Antelope Squirrel	1			4	1		2					8	8			
	Desert Cottontail				1			1					2	2			
OG	Whitetail Antelope Squirrel						1		1				2	2			
	Desert Cottontail	7		3		3	3	1	1				18	18			
PJ	Desert Cottontail	7	3	1									11	11			
SJ	Desert Cottontail	2	1	2		1		2	2				10	10			
	Unidentified, Chiroptera	1											1	1			
OJ	Colorado Chipmunk			2									2	2			
	Desert Cottontail								3				3	3			
	Unidentified, *Eutamias*									1			1	1			
PS	Whitetail Antelope Squirrel		1					1		1			3	3			
	Desert Cottontail	4		1	1								6	6			
SS	Desert Cottontail	4											4	4			
OS	Whitetail Antelope Squirrel			1									1	1			
PR	Mule Deer	1			3		1	2	3	3			13	13			
	Domestic Cattle	3		2	5	1	1	4	1	9	4	1	31	31			

TABLE ... . Mammal numbers, estimated wet weight biom and distance from transect l on sampling sites during October 1975 sampling perios

PG = primary greasewood,
SG = secondary greasewood,
OG = off-tract greasewood,
PJ = primary juniper,
SJ = secondary juniper,
OJ = off-tract juniper,
PS = primary shadscale,
SS = secondary shadscale,
OS = off-tract shadscale,
PR = primary riparian,
OR = off-tract riparian,
RG = riparian greasewood.

ge 2)	TABLE 6 (CONTINUED).	DISTANCE (m)											NO. SAMPLES	DENSITY			
														NUMBER		BIOMASS (kg)	
MPLING SITE	MAMMAL (SPECIES)	0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-75	76-100	>100		OBSERVED	PER HA	OBSERVED	PER HA
OR	Desert Cottontail			1									1	1			
	Mule Deer	1						1					2	2			
	Domestic Cattle	7		3	2	5	3	4					24	24			
RG	Desert Cottontail	7		4	4	3	1	2	2				23	23			

ge1)	TABLE 7. [See title opposite]	NUMBER CAPTURED					NUMBER CAPTURED FIRST TIME					DENSITY			
		DAY					DAY					NUMBER		BIOMASS (kg)	
mpling SITE*	RODENT (SPECIES)	1	2	3	4	5	1	2	3	4	5	OBSERVED	PER HA	OBSERVED	PER HA
PG 4 trap hts only)	Apache Pocket Mouse	2	-	-	-	-	2	-	-	-	-	2			
	Ord Kangaroo Rat	3	-	-	-	-	3	-	-	-	-	3			
	Deer Mouse	4	-	-	-	-	4	-	-	-	-	4			
SG trap ght only)	Apache Pocket Mouse	3	-	-	-	-	3	-	-	-	-	3			
	Deer Mouse	4	-	-	-	-	4	-	-	-	-	4			
	Desert Woodrat	2	-	-	-	-	2	-	-	-	-	2			
OG	Apache Pocket Mouse	0	5	5	9	5	0	5	3	4	0	12			
	Deer Mouse	6	7	8	6	6	6	2	2	1	2	13			
	Desert Woodrat	1	1	2	1	2	1	0	1	0	0	2			
PJ 4 trap ghts only)	Apache Pocket Mouse	2	-	-	-	-	2	-	-	-	-	2			
	Deer Mouse	3	-	-	-	-	3	-	-	-	-	3			
	Pinyon Mouse	2	-	-	-	-	2	-	-	-	-	2			
	Desert Woodrat	2	-	-	-	-	2	-	-	-	-	2			
SJ	Colorado Chipmunk	1	0	0	0	0	1	0	0	0	0	1			
	Apache Pocket Mouse	3	4	5	5	4	3	1	2	1	0	7			
	Deer Mouse	2	2	2	2	2	2	1	1	0	0	4			
	Pinyon Mouse	0	0	0	0	1	0	0	0	0	1	1			
	Desert Woodrat	2	3	3	3	3	2	1	1	0	0	4			
OJ 4 trap hts only)	Apache Pocket Mouse	1	-	-	-	-	1	-	-	-	-	1			
	Deer Mouse	3	-	-	-	-	3	-	-	-	-	3			
	Desert Woodrat	1	-	-	-	-	1	-	-	-	-	1			
PR	Deer Mouse	3	3	3	4	5	3	0	1	1	1	6			

TABLE . Number of rodents capture within rodent trapping transects on sampling sites during October 1975 sampling period (24 Sherman live tr for 5 days = 120 trap nights per sampling site, except where otherwise indicated). PG = primary greasewoo SG = secondary greasewood, OG = off-tr greasewood, PJ = primary juniper, SJ = secondary juniper, OJ = off-tract juniper, PR = primary riparian, OR = off-tract riparian.

* No trapping was done on the followi sampling sites due to inclement weath primary shadscale, secondary shadsc off-tract shadscale, riparian greasewo

ge 2)

TABLE 7 (CONTINUED).

PLING SITE	RODENT (SPECIES)	NUMBER CAPTURED					NUMBER CAPTURED FIRST TIME					DENSITY			
		DAY					DAY					NUMBER		BIOMASS(k)	
		1	2	3	4	5	1	2	3	4	5	OBSERVED	PER HA	OBSERVED	PER HA
CR	Apache Pocket Mouse	0	0	1	2	1	0	0	1	1	0	2			
	Deer Mouse	1	0	2	2	2	1	0	2	1	1	5			

B. TERRESTRIAL VERTEBRATES
2. LARGE MAMMAL MONITORING

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
9/2	¼ mile upstream from mouth of Asphalt Wash Sagebrush-Shadscale	Radio	.09	
9/2	Junction of Wagon Hound Road & Road to A-3. Juniper	Ocular	Two does & Three fawns.	
	¼ mile South of A-3 along road. Sagebrush-Shadscale	Ocular	One buck (2 point).	
9/3	Riparian area ato mouth of Hell Hole Canyon Riparian	Ocular	One doe and one fawn.	
	½ mile upstream from mouth of Cowboy Canyon Riparian	Radio	.05	Signal poor
9/8	Under Evac. pipeline. Riparian	Ocular	Three does & two fawns.	
	Under Evac. pipeline Riparian	Radio	.06	Signal poor

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
9/17	North side of river at mouth of Asphalt. Riparian	Ocular	Two does, two fawns & one buck (2 point).	
9/29	Mouth of Southam Canyon Riparian	Ocular	One doe & one fawn.	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
10/14	½ mile up Wagon Hound Canyon from Bridge. Sagebrush-Shadscale	Ocular	Two does & Two fawns.	
	¼ mile above White-river Bridge. Riparian	Ocular	Four does & Three fawns One doe & 0 fawn	No collars
10/17	Evac. Creek Bridge Riparian	Ocular	One doe & One fawn Three does & Two fawns	No collars
10/21	½ mile North of mouth of Southam in Canyon. Sagebrush-shadscale.	Ocular	Five does & four fawns	No collars
10/23	½ mile upsteam from Evac. Creek Bridge Sagebrush-Shadscale.	Ocular	Two does & Three fawns One doe & 0 fawns Two does & Two fawns	No collars. Seen in mixed Riparian & Sagebrush-Shadscale Habitats.
10/25	¼ mile-½ mile up Evac. Creek from mouth. Riparian	Ocular	One doe & One fawns One doe & One fawn Two does & One fawns	No collars
10/28	White River from Evac. pipeline to Hell Hole Mouth. Riparian	Ocular	Two does & Three fawns Two does & Two fawns Three does & Two fawns One doe & 0 fawn One doe & 1 fawn One doe & 1 fawn One doe & 1 fawn One doe & 0 fawn.	No collars

APPENDIX II

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMME
10/24	Mouth of Cowboy Canyon Riparian	Radio	.05	
	1/8 mile above Evac. pipeline Riparian	Radio	.06	
10/27	¼ mile upstream from of Asphalt . Riparian	Radio	.09	
10/28	½ mile N. W. of Southam Mouth Sagebrush-Shadscale	Radio	.07	Weak signal in Canyon
10/30	½ mile above Evac. pipeline. Riparian	Radio	.06	
	¼ mile downstream from mouth of Cowboy. Riparian	Radio	.05	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
10/30	Duck Rock Sagebrush-shadscale.	Ocular	One doe & one fawn	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	UMBER & CLASSIFICATION	COMMENTS
11/4	Mouth of Evac. Creek Riparian	Ocular	3 does 2 fawns	
	Mouth of Cowboy Canyon on North side Riparian	Ocular	7 unclassified	
	Ignacio Riparian	Ocular	2 does 2 fawns	
	North across river from X-2 Riparian	Ocular	3 unclassified	
11/5	Mouth of Asphalt Wash Riparian	Ocular	4 unclassified	
	A-11 Juniper	Ocular	5 does 3 fawns	
	¼ mile above Ignacio on North side of river Riparian	Ocular	3 does 3 fawns	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
11/17	¼ mile up Evac. Creek from mouth Riparian	Ocular	3 does 2 fawns	
	Evac. bridge Riparian	Ocular	2 does 2 fawns – 1 buck	
11/19	Evac. bridge Riparian	Ocular	3 does 2 fawns	
11/25	Under Evac. pipeline Riparian	Ocular	5 unclassified	
	1/8 mile downstream from mouth of Cowboy Canyon on North side of river.	Ocular	6 unclassified	
	Riparian			

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	UMBER & CLASSIFICATION	COMMENTS
11/4	½ mile above Evac. pipeline Riparian	Radio	.06	
	South side of river from Cowboy mouth Riparian	Radio	.05	
	Across river from X-2. Riparian	Radio	.02	
11/5	Under Evac. pipeline Riparian	Radio	.06	
	½ mile due north of S-12 Sage-Shadscale	Radio	.09	
11/12	Under Evac. pipeline. Riparian	Radio	.06	
	Across river (North) from F-5	Radio	.09	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
11/17	½ mile downstream from mouth of Cowboy canyon on South Side of river Riparian	Radio	.05	
	¼ mile below Evac. pipeline Riparian	Radio	.06	
	¼ mile West of X-2 on North side of river. Riparian	Radio	.02	
11/19	Under Evac. pipeline Riparian	Radio	.06	
	On North side of river F-5 Riparian	Radio	.09	
11/25	¼ mile above Evac. pipeline on North side of river Riparian	Radio	.06	
	1 ½ mile due North of S-4 on North side of river Riparian	Radio	.02	

DATE	LOCATION AND VEGETATION TYPE	SIGHTING TYPE	NUMBER & CLASSIFICATION	COMMENTS
11/25	½ mile down-stream from mouth of Cowboy Canyon on North side of river.	Radio	.05	
	Riparian			

C. TERRESTRIAL INVERTEBRATES - IDENTIFICATION LIST OF INSECTS

INSECTS OF OIL SHALE TRACTS, BONANZA, UTAH

Diptera

TEPHRITIDAE
Neaspilota sp #1
Tephritis avaneosa Coq.
Aciurina ferruginea Doane
Paraterellia sp #1
Euaresta aequalis Lw.
Euaresta tapetis Coq.
Paroxyna clathrata Lw.
Paroxyna sp. #1
Paroxyna sp. #2
Paracantha cultaris Coq.
Procecidochares minuta (Snow)
Procecidochares sp #1
Tripanea bisetosa Coq.
Trupanea wheeleri Curr.
Trupanea nigricoris Coq.
Trupamea sp #1
Oxyna utahensis Quisen
Oxyna aterimma Doane
Eutreta diana (O.S.)
Genus #1 sp #1
OTTI
OTTITIDAE
Melieria canus Loew.
Physiophora demandata (F.)
Ceroxys latiuscula (Loew)
Otites pyrrhocephala (Loew)
Otites sp #1
Oedopa capito Loew
Paroedopa punctigera Coq.?
Tritoxa pollinosa Cole
Tritoxa sp #1
Euxesta nitidiventris (Loew)
Euxesta sp. #1
Genus #1 sp #1
Genus #1 sp #2

SEPSIDAE
Sepsis neocynipsea M & S
Sepsis biflexuosa M & S

ANTHOMYZIDAE
Anthomyza sp #1

DROSOPHILIDAE
Scaptomuza sp #1
Scaptomyza sp #2
Drosophila sp #1

LONCHAEIDAE
Lonchaea sp #1
Dasiops sp #1
" sp #2
" sp #3

AGROMYZIDAE
Agromyza sp #1
" " sp #2
" " sp #3
Melanagromyza sp #1
Melanagromyza sp #2
Ophomyia sp #1
" " sp #2
" " sp #3
" " sp #4
Phytagromyza sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6
Ceradonta sp #1
Ceradonta sp #2
Haplomyza sp #1
Liriomyza sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6
" " sp #7
" " sp #8
Phytobia sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
Phytoliriomyza sp #1

MICROPEZIDAE
Micropeza sp #1

ASTEIDAE
Asteia multipunctata Sabr.

Chamaemyiidae
Chamaemyia sp #1
Leucopis sp #1
" " sp #2
" " sp #3

SCIOMYZIDAE

Pherbellia nana (Fall.)

TRIXOSCELIDAE

Trixoscela sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6
Spilochroa sp #1

TETHINIDAE

Pelomyia coronata Lw.
Tethina sp #1
Pelomyiella mallochi (Sturt.)
Pelomyiella melanderi (Sturt.)

LAUXANIIDAE

Camptoprosopella borealis Shew.
Minettia sp #1

HILARIMORPHIDAE

Hilarimorpha sp #1

SPHAEROCERIDAE

Leptocera sp #1
" " sp #2
" " sp #3

EPHYDRIDAE

Atissa sp #1
Allotrichoma sp #1
Allotrichoma sp #2
Ditrichophora sp #1
Discocerina sp #1
Discocerina sp #2
Ephydra nacellaria Egg.
" sp #1
" sp #2
Hydrellia sp #1
" " sp #2
" " sp #3
Mosillus tibialis Cress.
Ochthera mantis D.G.
Notiphilus sp #1
Pelina truncata Loew
Pelina sp #1
Illythea sp #1
Philygrid debilis Loew.
Paracoenia bisetosa Coq.

EPHYDRIDAE (continued)

Paracoenia turbida Curr.
Paracoenia sp #1
Parydra parasocia Claus.
Psilota compta (Meig)
Psilota olga Cress.
Lamproscatella sp #1
Scatella sp #1
Scatella sp #2
Genus #1 sp #1

CHLOROPIDAE

Chlorops lituratus Adams
Chlorops sp #1
Aphanotrigonum sp #1
Diplotoxa sp #1
" " sp #2
" " sp #3
" " sp #4
Diplotoxa recurra Adams
Lasiosina approximatonervis Loew
Lasiosina sp #1
Meromyza pratorum Meig
Thaumatomyia appropinqua Adams
Thaumatomyia sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
Cetema sp #1
Hapleginella conicola Greene
Gaurax sp #1
Elachiptera sp #1
Oscinella sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6 and sp #7
Olcella sp #1
" " sp #2
" " sp #3
" " sp #4
Hippelates pusio Loew
Hippelates sp #1
Siphonella neglecta Becker
" " sp #1
" " sp #2
" " sp #3
Eribolus nanus Becker
Lasiopleura sp #1
Genus #1 sp #1
Genus #2 sp #1
Genus #2 sp #2

MILICHIIDAE

Milichiella sp #1
Milichiella sp #2
Hemeromyia washingtona Meig.?
Hereromyia sp #1
Meoneura sp #1
Meoneura sp #2
Madiza glabra
Pholeomyia sp #1
Eusiphona sp #1
Leptometopa halteralis
Leptometopa latipes Meig.
Leptometopa sp #1
Desmometopa sp #1

SYRPHIDAE

Asemosyrphus polygrammus Lw.
Allograpta obliqua Say
Ceriana tridens Lw.
Baccha lemur O.S.
Eumerus strigatus Fall.
Eristalis tenax (L.)
Eristalis stipitator O.S.
Eupeodes volucris O.S.
Helophilus latifrons Lw.
Chrysotoxum integre Will.
Chrysotoxum ventricosum Lw.
Melanostoma sp #1
Melanostoma sp #2
Paragus bicolor F.
Paragus tibialis Fall.
Platycheirus sp. #1
Neocnemodon sp #1
Mesogramma marginata Say
Scaeva pyrastri L.
Syrphus sp #1
Metasyrphus sp #1
Tropidea quadrata Say
Sphaerophoria sp #1
Xylota flavitibia Bigot
Xylota sp #1
Volucella satura O.S.
Volucella candata Cum.
Syritta pipiens (L.)

CONOPIDAE

Physocephala texana Will.
Zodion fulbifrons Say
Zodion cinereiventre V.D.
Zodion americanum Weid.
Thecophora propinqua Adams
Thecophora nigripes Cam.
Robertsonmyia parva V.D.

STRATIOMYIDAE

Sargus cuprarius (L.)
Nemotelus canadensis Lw.
Nemotelus cammunus Hanson
Nemotelus sp #1

TABANIDAE

Silvius quadrivitattus Say
Tabanus punctifer L.

THEREVIDAE

Thereva johnsoni Coq.
Thereva fucata Loew.
Thereva sp #1

PHORIDAE

Megaselia sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
Phora velutina (Meig.)

EMPIDAE

Hemerodromia sp #1
Platypalpus sp #1
Platypalpus sp #2
Hilara sp #1
Neoplasta sp #1
Drapetis sp #1
Empis sp #1
" sp #2
" sp #3

BOMBYLIIDAE

Villa sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6
" " sp #7
Villa lepidota (O.S.)
Villa Syrtis Coq.
Villa lateralis Say
Villa capra Coq.
Villa morio (L.)
Villa sinuosa Weid.
Anthrax irroratus Say
Anthrax piesia Curran
Anthrax limatulus artemisia Marst.
Dipalta serpentina O.S.

Epacmus sp #1
Systoechus vulgaris Lw.
Toxophora virgata O.S.
Geron sp #1
" sp #2
" sp #3
" sp #4
" sp #5
Phthiria sulphurea Lw.
Phthiria sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6
" " sp #7
" " sp #8
Oligodranes sp #1
" " " sp #2
" " " sp #3
Peocilanthrax signatipennis (Cole)
Poecilanthrax willistoni (Coq.)
Exoprosopa caliptera Say
Neacreotrichus sp #1
Mythicomyia sp #1
" " sp #2
" " sp #3
" " sp #4
" " sp #5
" " sp #6
" " sp #7
" " sp #8
" " sp #9
" " sp #10
" " sp #11
" " sp #12
" " sp #13
" " sp #14
" " sp #15
" " sp #16
" " sp #17
Mythicomyia atra Cress.
Prorates sp #1

ASILIDAE
Proctocantha nearno Tns.
Efferia sp #1
" " sp #2
" " sp #3
Promachus aldrichii Hine

ASILIDAE (continued)
Philonicus sp #1
Mallophorina guildiana Will.
Stichopogon trifasciatus Say
Asilus cumbipilosa Addison
Asilus mesae Tucker
Asilus compositus Hine
Holopogon atrifrons Cole
Holopogon albipilosus Curran
Holopogon sp #1
Holopogon sp #2
Asilus tuxpanganus Ball
Asilus vescus Hine
Wilcoxia cineria James
Leptogaster sp #1
" " " sp #2
" " " sp #3
" " " sp #4

D. AQUATIC BIOLOGY

1. QUALITATIVE ALGAE - PERIPHYTON

E-1 periphyton - algae

Collected IX-30-75

Field note: Vaucheria & Spirogyra growing in mats along left bank 100' downstream of Hells Hole Canyon. ~~E~~ These genera abundant only at this station. Diatoma growing in clumps on barely submerged rock shelf; yellow-green to dark brown - slimy feel. clumps to 5 cm. long.

Diatoma vulgare	- abundant
Ulothrix sp	common
Chaetophora (?) sp	rare
Gomphonema	Abund
Synedra spp	common
Surirella	Rare
Mougeotia	infrequent
Spirogyra	common
Navicula	abundant

F-2 Algae-periphyton

Collected IX-26-75

Field note: Algal community on shallowly submerged stones less conspicuous than anticipated ~~not~~ green color not apparent from river banks.

Lab note:

Cladophora sp	Dominant (#1)	
Cocconeis placentula	#2	± equal
Diatoma vulgare	#3	
Gomphonema olivaceum	#4	
Navicula spp	#5	
Nitzschia spp	#6	
Synedra spp	7	
Fragilaria capucina	8	
Surirella sp	9	
Gyrosigma sp	10	
Epithemia *sorex*	11	

(F-2 cont)

Cylindrotheca gracilis	12
Rhopalodia sp	13
Amphiprora palludosa	14
Oscillatoria sp	15

Cladophora clearly most abundant, followed by + equal numbers of Cocconeis, Diatoma and Gomphonema Navicula & Nitzschia common, others infrequent to rare.

F-3 Periphyton Collected IX-25-75

Scraped from periphyton float and metal frame of turbidimeter. Little to no algae on periphyton strips - abundant growth on the float itself.

Cladophora sp.	abundant (#1 sp)
Diatoma vulgare	# 2 (order abundanc
Navicula spp	#3
Cymbella sp	# 4
Fragillaria sp.	#5
Diatoma hiemale	#6
Gomphonema	7 (uncommon)
Rhoicosphenia	8 Rare
Anabena	Rare

Note absence of Cocconeis sp.

F-5 Algae - Periphyton Collected IX-30-75

Field note: Collected from periphyton boat anchored at station A-11. Boat was waterlogged; only 1 periphyton strip remained. It was covered with silt.

Genera	Order of abundan
Cladophora (glomerata?)	#1 Abun
Epithemia sorex	#2 "
Cocconeis placentula	3 "
Navicula spp	4 "
Gomphonema olivaceum	5 "
Synedra sp	6 commo
Diatoma vulgare	7 "
Cylindrotheca (gracilis?)	8 "
Rhopalodia sp.	9 "
Pinnularia sp	10 "
Tabellaria sp	11 "
Microspora sp	12 Infreq.

(F-5 IX-30-75 Cont)

Amphiprora pellucida	13	Rare
Protozoa (Ciliata)	14	Rare
Ceratium	15	Rare

D. AQUATIC BIOLOGY

2. EKMAN DREDGE SAMPLE DATA

Ekman Dredge Samples

F-1 Collected X-01-75

	total capture
Ekman #1	
Ophiogomphus *severus*	1
Ekman 2	0
Ekman 3	
Ophiogomphus severus	1
Ekman 4	0
Ekman 5	0

Taken from sandy silt substrate 50± meters upstream from gage.

F-2 Ekman Samples Collected IX-26-7

Ekman Sample		total
#1	Ceratopogonidae	1
#2		0
#3		0
#4	Ophiogomphus severus	4
	Limnodrilus claparedianus	5
	Ceratopogonidae	1
	total	10
#5	Ophiogomphus severus	1
	Ceratogonidae	1
	Limnodrilus (?) sp	1
	~~Rh~~ Rhithrogena undulata	1
	Chironomidae (Stictochironomus)	1
	total	5

15 / 5 samples

average. 3 / 36 in^2 - 12/ft^2

E-3 Ekman Samples

Collected IX-25-75

Sample #		total
1		0
2		0
3	Ophiogomphus severus	2
4		0

average 2 organisms/ft^2

F-4 Ekman Sample Collected IX-24-75

Sample			total
1	Ceratopogonidae	1	
	Simuliidae	1	2
	~~Chironomidae~~		
2			0
3	Chironomidae	1	
	Limnodrilus claparedianus	3	
			4

F5 Ekman Collected IX-30-75

Ekman		total
1		0
2		0
3	Ophiogomphus severus	1
4		0
5	Chironomidae	1

D. AQUATIC BIOLOGY

3. QUALITATIVE PLANKTON DATA - SEDGEWICK RAFTER COUNTS

F-1 & 2 collected X-01-75 69 ml concentrat

Cell 1

Strips	Count	Genera
1	101	Cylindrotheca
2	96	
		Navicula
3	110	
4	102	Epithemia sorex
	409	

2045/ml conc
64/ml H_2O

(#1) Cocconeis

Cell 2

1	74	Chaetophora
2	111	
3	107	Diatoma
4	100	Surirella
	392	(rare)

1960/ml conc

61/ml H_2O

Cladophora

Cells 3

1	93
2	116
3	101
4	104
	414

Synedra

2070/ml conc
65/ml H_2O

ofR

$\bar{X}$ 63/ml H_2O
63,000/l

F-2 α2

89 ml concentrate
collected IX-26-75

cell 1

strip	count
	80
1	79
2	
3	102
4	127
	388

78/ml H_2O

cell 2

strip	count
1	114
2	115
3	110
4	99
	438

3190/ml concentrate
89/ml H_2O

Cell 3

strip	count
1	129
2	102
3	107
4	132
	470

3350/ml concentrate

95 cells/ml H_2O

Genera

Gomphonema

Diatoma

Nitzschia
(several spp.)

Fragilaria

Cymbella

☆ Closterium
(only 1 seen)

Cladophora

F-3 Quantitative (21) 74 ml. concentrate
Coll. date IX-25-75

Cell 1

Strip	Count
1	167
2	184
3	214
4	155
	720

3600 cells/ml Concentrate

121 cells/ml H_2O

Cell 2

1	159
2	149
3	137
4	166
	611

3055 / ml conc.

103 / ml H_2O

103,000 / L.

Synedra
Cocconeis
Navicula
Cymbella
Cladophora
Gomphonema
Schroederia
Diatoma
Nitzschia
Epithemia
F. capucina

Rhopalodia

E-3 α1 cont (IX-25-75)
Cell 5

strip	Count
1	177
2	151
3	136
4	184
	648

3240 cells/ml conc
109 cells ml H_2O
(108,981 cells/liter)

CFR

5-4 α3 60 Ml

cell 1

strip	count
1	89
2	76
3	111
4	71
	347

1735

47.32 cells/l H_2O

~~cell 2~~

cell 2

strip	count
1	80
2	81
3	116
4	68
	345

47.0

cell 3

1	109
2	121
3	102
4	112
	439

59.9 cells/ml H_2O

F-5 & 1 86 ml concentrate
collected & analyzed IX-30-75

Cell #1

Strip	cymbella	Count
1	Pleurosigma	83
2	Cylindrotheca (scarce)	82
3		104
4		106
		385

1925/ml Conc
78 /ml H_2O

1	62
2	93
3	93
4	85
	333

1665 /ml Conc
67 /ml H_2O

F5
d1

cell 3

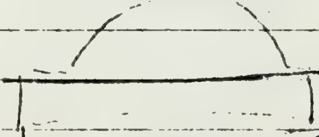
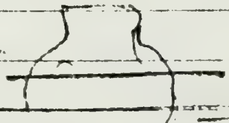
strip	count
1	124
2	101
3	99
4	88
	412

~~Achnanthes~~
Rhoicosphenia
Nematodes
Synedra

CFR

2060/ml conc
93/ml H_2O

F-5 Algae
Epithemia abundant
Amphipleura
Navicula
Cocconeis
Cosmarium (rarely)
Gomphonema
Rhopalodia (rare)

Epithemia sorex common to abund
Synedra
Nitzschia sigmoidea

F-6 R sample 1 100 ml concentrate
Collected IX-26-75

Cell #1

Strip	Count	Genera
1	135	#1 Cylindrotheca
2	112	Navicula
3	234	Diatoma
4	146	Fragillaria
	627	Anabena
3135 cells/ml concentrate		Opephora
143 cells/ml H_2O		Vaucheria (rare)

Cell ~~Strip~~ # 2 count

1	199	Rhopalodia
2	127	
3	214	
4	155	
	695	

3475 cells/ml concentrate

158 cells/ml H_2O

F-4 & 1

Cell 3

Strip	count
1	108
2	116
3	149
4	189
	562

2810 cells/ml concentrate

128 cells/ml H_2O

1
143
158
128

$\frac{429}{3}$ = 143 cells/ml average

CHR

D. AQUATIC BIOLOGY

4. INVERTEBRATE DATA - SURBER SAMPLES

MACROINVERTEBRATE LAB WORKSHEET

Station No. F-1 Sample No. 1 Sampling Method Rual (Series) & Surber Project NO. 617-1 Collection Date X-01-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* ✓		1
		Rhithrogena	*undulata* ✓		6
	Baetidae	*Baetis* SPP	~~*bicaudatus*~~ ✓		15
		Pseudocloeon	✓		
		Callibaetis			
		Ephemerella	✓		
		Trichorythodes	*minutus* ✓		36
		Lachlania	✓		
		Traverella	*albertana* ✓		27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus* ✓		45
	Libellulidae				
	Aeschnidae				
[illegible]ecoptera	Perlodidae	*Isogenus*	✓		
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	✓		
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae	[illegible]	✓		
		Rhagovelia	✓		
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae		✓		
	Culicidae				
	Chironomidae		✓		
	Ceratopogonidae "				
	[illegible] "		✓		
			TOTAL		

Biologist

Total Number of Taxa 16

F-1 is more productive than this indicates -- several small stones from deeper H_2O up to 20 Traverella

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

Station No. F-1 Sample No. 1 Sampling Method SURBER Collection Date X-01-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	**Heptageniidae**	*Heptagena*	*elegantula* 17+1	~~18~~ 19	1
		~~[illegible]~~)	9	~~1~~	
		Rhithrogena	*undulata* 9	9	6
	Baetidae	*Baetis*	*bicaudatus* 24	24	15
		sp	B 3	3	
		Callibaetis			
		Dactylobaetis	~~5~~ 6	6	
		Ephemerella	3+11+3=	17	
		Trichorythodes	~~minutus~~ edmundsi	1	36
		Lachlania			
		Traverella	*albertana* 9	9	27
Odonata	**Gomphidae**	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	**Perlodidae**	*Isogenus*			
		Arcynopteryx			
		Isogenoides	Colubrinus	2	
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	**Hydropsychidae**	*Hydropsyche*	4	4	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	**Mesoveliidae**	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	**Dytiscidae**	*Agabus*			
	Elmidae				
Diptera	**Simuliidae**		pupa	1	
	Culicidae				
	Chironomidae			2	
	Ceratopogonidae				

TOTAL 97

Biologist

Total Number of Taxa 12

$\bar{d} = 3.0$

ost Traverella near emergence
phemerella all early instar
seudocleon mixed

(instars?)

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-1

Station No. F-1 Sample No. 2 Sampling Method Surb Collection Date X-01-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	Heptagena	elegantula [illegible]	52	1
		Rhithrogena	undulata mostly very early	8 ~~+2~~	6
	Baetidae	Dactylobaetis		3	
		Baetis	bicaudatus		15
			sp. A	2	
		~~Callibaetis~~	sp. B	9	
		Ephemerella	i[illegible]is (?)	~~10~~ 11	
		Trichorythodes	minutus		36
		Lachlania			
		Traverella	albertana [illegible] last instar	32	27
Odonata	Gomphidae	Gomphus	intricatus		43
		Ophiogomphus	severus	1	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	Isogenus Arcynopteryx			
	Perlidae	Taenionema Acroneuria	pacifica		65
Trichoptera	Hydropsychidae	Hydropsyche		5	
	Limnephilidae Brachycentridae	Brachycentrus			
Hemiptera	Mesoveliidae Gerridae	Mesovelia	mulsanti		81
Coleoptera	Dytiscidae	Agabus			
	Elmidae				
Diptera	Simuliidae Culicidae Chironomidae			1	
	Ceratopogonidae				

TOTAL 125

Biologist Clay Total Number of Taxa 10

Traverella most [illegible] (Est). $\bar{d} = 2.55$

Ophiogomphus ± = all others

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1617

Station No. F1 Sample No. 3 Sampling Method Surber Collection Date X-01-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	**Heptageniidae**	*Heptagena*	*elegantula* ~~17~~ 19	19	1
		Rhithrogena	*undulata* 3	3	6
	Baetidae	~~*Baetis*~~	~~*bicaudatus* 1~~		15
		Pseudocloeon	1	1	
		Callibaetis			
		Ephemerella			
		Trichorythodes	*minutus*		36
		Lachlania			
		Traverella	*albertana* 10	10	27
Odonata	**Gomphidae**	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	**Perlodidae**	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	**Hydropsychidae**	*Hydropsyche*	4	4	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	**Mesoveliidae**	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	**Dytiscidae**	*Agabus*			
	Elmidae				
Diptera	**Simuliidae**				
	Culicidae				
	Chironomidae			2	
	Ceratopogonidae				

TOTAL 39

Biologist CRay Total Number of Taxa 6

d = 1.99

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-1

Station No. E-1 Sample No. 4 Sampling Method SURBER Collection Date X-01-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula* 33+11	44	1
		Rhithrogena	*undulata*	14	
	Baetidae	*Baetis*	(trilail)	3	6
					15
		Pseudocloeon	*turbidum*	7	
		Dactylobaetis	*cepheus*	3	
	Ephemerellidae	*Ephemerella*		9	
	Trichorythidae	*Trichorythodes*	minutus	2	
					36
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*	1	27
	Leptophlebiidae	*Trauerella*	*albertana* 75+10+[illegible] 11	122	
					43
		Ophiogomphus	*severus*	2	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*		2	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		3	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae	pupa 3	larva 3	6	
	Culicidae				
	Chironomidae			7	
	Ceratopogonidae				

TOTAL 225

Biologist

Total Number of Taxa 14

d = 2.31

MACROINVERTEBRATE LAB WORKSHEET

Project NO 1517-17

Station No. F-1　Sample No. 5　Sampling Method Surber　Collection Date X-01-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula*	21	1
		Rhithrogena	*undulata*	22	
					6
	Baetidae	*Baetis*	SpA (tricaud)	4	
					15
		Pseudoclueon	*turbidum*	9	
		Dactylobaetis	*cepheus*	4	
	Ephemerellidae	*Ephemerella*	inermis ?	21	
	Trichorythidae	*Trichorythodes*	minutus	1	
					36
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*	11	27
	Leptophlebiidae	*Trauerella*	*albertana* 100+20+ 卌卌卌 |	136	
					43
		Ophiogomphus	*severus*	4	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogen*oides		12	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		19	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*	[illegible]	81
	Gerridae				
	Veliidae	Rhagovelia	distincta	2+	
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae			2	
	Culicidae				
	Chironomidae			9	
	Ceratopogonidae				
			TOTAL	281	

~~[illegible]~~ Rhagovelia accidental wash ins.

Biologist C Foy　Total Number of Taxa ~~[illegible]~~ 15

Dead on capture? If so, in good condition

d = 1.5

+ others

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

Station No. F-2 Sample No. ______ Sampling Method Qual Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	**Heptageniidae**	*Heptagena*	*elegantula*	✓	1
		Rhithrogena	*undulata*		6
	Baetidae	*Baetis*	*bicaudatus*		15
		Callibaetis			
		Ephemerella		✓	
		Trichorythodes	*minutus*		36
		Lachlania			
		Traverella	*albertana*	✓	27
		Choroterpes	albiannulata	✓	
Odonata	**Gomphidae**	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	**Perlodidae**	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	**Hydropsychidae**	*Hydropsyche*		✓	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	**Mesoveliidae**	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	**Dytiscidae**	*Agabus*			
	Elmidae				
Diptera	**Simuliidae**				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				

TOTAL ______

Biologist ______ Total Number of Taxa 5

+ traverella mostly late to last instar

MACROINVERTEBRATE LAB WORKSHEET

Project NO. ______

Station No. F-Z Sample No. 1 Sampling Method Qual Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* ✓		1
		Rhithrogena	*undulata* ✓		6
	Baetidae	*Baetis*	~~*bicaudatus*~~ ✓		15
		DActylobaetis	[illegible] ✓		
		Callibaetis			
		PSEUdocloEON	✓		
		Ephemerella	✓		
		Trichorythodes	*minutus*		36
		Lachlania			
		Traverella	*albertana* ✓		27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	✓		
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae	✓			
	Culicidae				
	Chironomidae	✓			
	Ceratopogonidae				
			TOTAL		

Biologist ______________ Total Number of Taxa ______

MACROINVERTEBRATE LAB WORKSHEET

Project NO. ______

Station No. F-Z Sample No. 1 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	Heptagena	elegantula ~~2~~ 42	42	1
		Rhithrogena	undulata 24	24	6
	Baetidae	Baetis	bicaudatus 69+1	70	15
		Dactylobaetis	2	2	
		Callibaetis			
		Ephemerella	3+4	7	
		Trichorythodes	~~minutus~~ edmundsi	4	36
	Subimago ←	Lachlania	1	1	
		Traverella	albertana 4+1	5	27
		Choroterpes	1	1	
Odonata	Gomphidae	Gomphus	intricatus		43
		Ophiogomphus	severus 2	2	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	Isogenus Arcynopteryx			
	Perlidae	Taenionema Acroneuria	pacifica		65
Trichoptera	Hydropsychidae	Hydropsyche	66	66	
	Limnephilidae Brachycentridae	Brachycentrus			
Hemiptera	Mesoveliidae Gerridae	Mesovelia	mulsanti		81
Coleoptera	Dytiscidae	Agabus			
	Elmidae				
Diptera	Simuliidae Culicidae Chironomidae		2	2	
	Ceratopogonidae				
		Limnephilus	2	2	

TOTAL 228

Biologist ______ Total Number of Taxa 13

$\bar{d} = 2.52$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-17

tion No. E-2 Sample No. 2 Sampling Method SURBER Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 6	6	1
		Rhithrogena	*undulata* 3 3+1	34	6
		BAETIS	SP A 2	2	
	Baetidae	*Baetis*	*bicaudatus* 36	36	15
		Dactylobaetis	2	2	
		Callibaetis			
		Ephemerella	~~3~~4	4	
		Trichorythodes	*minutus*		35
		Lachlania			
		Traverella	*albertana* 18	18	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*	3	3	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	5	5	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae	many puparia	3	3	
	Culicidae				
	Chironomidae		Sp A 2	2	
			Sp B 1	1	
	Ceratopogonidae				
		Limnodrilus	1	1	
		naidium	1	1	
			TOTAL	118	

Biologist

Total Number of Taxa 14

$\bar{d} = 2.62$

20 very few Traverella
Gomphids nearly equal -- all others in biomass

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 151747

Station No. F-2 Sample No. 3 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES		NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	~~28~~ 39	39	1
		Rhithrogena	*undulata*	~~22~~ 8	8	6
	Baetidae	*Baetis*	*bicaudatus*	~~20~~ 21	21	15
		[illegible] →	P	3	3	
		Callibaetis				
		Dactylobaetis		~~2~~4	4	
		Ephemerella		7	7	
		Trichorythodes	~~*minutus*~~	Sebrunski	5	36
		Lachlania				
		Traverella	*albertana*	11	11	27
Odonata	Gomphidae	*Gomphus*	*intricatus*			43
		Ophiogomphus	*severus*	(near emergence)	~~2~~ 2	45
	Libellulidae					
	Aeschnidae					
Plecoptera	Perlodidae	*Isogenus*				
		Arcynopteryx				
	Perlidae	*Taenionema*	*pacifica*			65
		Acroneuria				
Trichoptera	Hydropsychidae	*Hydropsyche*		9	9	
	Limnephilidae					
	Brachycentridae	*Brachycentrus*				
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*			81
	Gerridae					
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae					
Diptera	Simuliidae			pupae	3	
	Culicidae					
	Chironomidae	orthocladius (?)			2	
	Ceratopogonidae					
	[illegible]				1	
			TOTAL		115	

Biologist C. K. Total Number of Taxa 12

$\bar{d}$ = 3.02

[illegible] & Hydropsyche I = biomass
Ephemerella immature
Hydropsyche & Pseudocloeon early to late

Choroterpes
nearly mature
(ready to emerg

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ation No. E2 Sample No. 4 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula*	23	1
		Rhithrogena	*undulata*	12	
					6
	Baetidae	*Baetis*	Sp. A	4	
					15
		Pseudocloeon	*turbidum*	20	
		Dactylobaetis	*cepheus*		
	Ephemerellidae	*Ephemerella*	inermis (?)	3	
	Trichorythidae	*Trichorythodes*	minutus	2	
					36
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*		27
	Leptophlebiidae	*Traverella*	*albertana* 46+|||	49	
		Choroterpes	albiannulata	4	
					43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
ecoptera	Perlodidae	*Isogenoides*	frontalis	1	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	73+1	74	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae	5 larvae, 2 pupae		7	
	Culicidae				
	Chironomidae *			5	
	Ceratopogonidae				
	Ephydridae			1	
		Limnodrilus	claparedianus	2	
		Pisidium	(casertanum?)	1	
			TOTAL	208	

Biologist ________ Total Number of Taxa 15

* 1 sp only - Orthocladius (?) $\bar{d} = 2.78$

2 spp Baetis - 4 c Slails - 5 c 2 (similar to Pseudocloeon but different color pattern

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ation No. E-2 Sample No. 5 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula* HH |||||	68	1
		Rhithrogena	*undulata* ||||	4	
	Baetidae	*Baetis*	sp. A	4	6
			Sp. B	5	
		Pseudocloeon	*turbidum*	19	15
		Dactylobaetis	*cepheus* (removed)	4	
	Ephemerellidae	*Ephemerella*	HH |||	17	
	Trichorythidae	*Trichorythodes*	minutus	1	
					36
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*		27
	Leptophlebiidae	*Traverella*	*albertana*	68	
					43
	Odonata	*Ophiogomphus*	*severus* 2	2	45
	Libellulidae				
	Aeschnidae				
lecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taeniopteryx*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	53 +1	54	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae	Chironomus	sp. E (1 pupa)	6	
			sp 2	2	
	Ceratopogonidae				
	Empididae			1	

TOTAL 255

Biologist

Total Number of Taxa 14

$\bar{d} = 2.76$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1577

Station No. F-3 Sample No. 1 Sampling Method SURBER Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	Heptagenia	elegantula #21	21	1
		Rhithrogena	undulata 7	7	
	Baetidae	Baetis	~~21 [illegible]~~	~~17~~	6
					15
		Pseudocloeon	turbidum	19	
		Dactylobaetis	cepheus 2	2	
	Ephemerellidae	Ephemerella			
	Trichorythidae	Trichorythodes	minutus	4	
					36
	Oligoneuriidae	Lachlania	saskatchewanensis		27
	Leptophlebiidae	Traverella	albertana 28	27	
		CHOROTERPES		1	
					43
Odonata	Gomphidae	Ophiogomphus	severus		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	IsogenoIDES	FRontalis	2	
		Arcynopteryx			
	Perlidae	Taenionema	pacifica		65
		Acroneuria			
Trichoptera	Hydropsychidae	Hydropsyche	10	10	
	Limnephilidae				
	Brachycentridae	Brachycentrus			
Hemiptera	Mesoveliidae	Mesovelia	mulsanti		81
	Gerridae				
Coleoptera	Dytiscidae	Agabus			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae		1	1	
	Ceratopogonidae				

TOTAL ~~95~~ 95

Biologist CR

Total Number of Taxa ~~9~~ 10

$\bar{d} = 2.66$

richorythodes, Pseudocloeon [illegible]
Dactylobaetis & Baetis c̄ mud ring pads

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 157-17

on No. E-3 Sample No. 2 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES		NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	42	42	1
		Rhithrogena	*undulata*	9	9	6
	Baetidae	~~*Baetis*~~ Pseudocloeon	~~*bicaudatus*~~		23	15
		Callibaetis				
		Dactylobaetis			4	
		Ephemerella				
		Trichorythodes	*minutus*	~~7~~ 4	4	36
		Lachlania				
		Traverella	*albertana*	~~44~~ ~~35~~ 45	45	27
Odonata	Gomphidae	*Gomphus*	*intricatus*			43
		Ophiogomphus	*severus*			45
	Libellulidae					
	Aeschnidae					
optera	Perlodidae	*Isogenus*				
		Arcynopteryx				
	Perlidae	*Taenionema*	*pacifica*			65
		Acroneuria				
Trichoptera	Hydropsychidae	*Hydropsyche*		4	4	
	Limnephilidae					
	Brachycentridae	*Brachycentrus*				
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*			81
	Gerridae					
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae					
Diptera	Simuliidae					
	Culicidae					
	Chironomidae				2	
	Ceratopogonidae					
			TOTAL		133	

Biologist CKay Total Number of Taxa 8

$\bar{d} = 2.30$ $\frac{133}{77}$

Trav 50
2 Trichorythodes minutus (?) & T. sp. each removed

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-17

on No. F-3 Sample No. 3 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	Heptagena	elegantula 18 +1 |||	22	1
		Rhithrogena	undulata 15+8+ ||||| |	29	6
	Baetidae	~~Baetis~~ Pseudocloeon	bicaudatus 38	38	15
		" sp	~~[illegible]~~ 2	2	
		Callibaetis			
		Ephemerella	6	6	
		TRICHORYTHODES	1	1	
		Trichorythodes	minutus	3	36
		Lachlenia			
		Traverella	albertana 71+ |||||	76	27
	Exuvium only	Ephoron			
Odonata	Gomphidae	Gomphus	intricatus		43
	2 near emergence	Ophiogomphus	severus 3	3	45
	Libellulidae				
	Aeschnidae				
ptera	Perlodidae	Isogenoides	Elongatus (?) 3 removed	5	
		Arcynopteryx			
	Perlidae	Taenionema	pacifica		65
		Acroneuria			
Trichoptera	Hydropsychidae	Hydropsyche	5(R) 5 REMOVED	56	
	Limnephilidae				
	Brachycentridae	Brachycentrus			
		Leptocella	1 REMOVED	1	
Hemiptera	Mesoveliidae	Mesovelia	mulsanti		81
	Gerridae				
Coleoptera	Dytiscidae	Agabus			
	Elmidae				
Diptera	Simuliidae		puparium 5+1	9	
	Culicidae				
	Chironomidae		4	4	
	Ceratopogonidae				
	EPHYDRIDAE			1	
	Naidinae		sp	1	
		Limnodrilus		1	
	NEMATODA			1	
			TOTAL	259	

Biologist CKay Total Number of Taxa 18

$\bar{d} = 3.13$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-1

ion No. E-3 Sample No. 4 Sampling Method Surber Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 28+1	29	1
		Rhithrogena	*undulata* ,	1	6
	Baetidae	*Baetis*	*bicaudatus* 27	27	15
		Dactylobaetis	'	1	
		Callibaetis			
		Ephemerelia	///	3	
		Trichorythodes	~~*minutus*~~ ~~[illegible]~~	2	36
		Lachlania			
		Traverella	*albertana* 29+1	30	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
ptera	Perlodidae	*Isogen*oides	/	1	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	14	14	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		31
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae	Orthocladius	sp 3	3	
		Chironomus	1	1	
	Ceratopogonidae				
iopora	Naididae	Naidium	osborni	2	
			TOTAL	114	

Biologist C. Pay Total Number of Taxa 11

$\bar{d} = 2.59$

2 parts

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ion No. F-3 Sample No. 5 Sampling Method SURBER Collection Date IX-26-75

ORDER	FAMILY	GENUS	SPECIES		NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	9+7	~~11~~ 17	1
		Rhithrogena	*undulata*	~~3+3+1+1+4~~	~~[illegible]~~ 46	6
	Baetidae	*Baetis*	~~*bicaudatus*~~		~~57~~	15
		"	Sp.		7 1	
		Callibaetis				
		Pseudocloeon			32	
		Ephemerella			3	
		Trichorythodes	~~*minutus*~~	~~[illegible]~~	1	36
		Lachlania				
		Traverella	*albertana*	~~25+49~~	74	27
Odonata	Gomphidae	*Gomphus*	*intricatus*			43
		Ophiogomphus	*severus*			45
	Libellulidae					
	Aeschnidae					
Plecoptera	Perlodidae	*Isogenus*oides			1	
		Arcynopteryx				
	Perlidae	*Taenionema*	*pacifica*			65
		Acroneuria				
Trichoptera	Hydropsychidae	*Hydropsyche*		11+23	34	
	Limnephilidae					
	Brachycentridae	*Brachycentrus*				
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*			81
	Gerridae					
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae					
Diptera	Simuliidae	Simulium 2 pupa		3	4	
	Culicidae					
	Chironomidae	Cricotopus	3		4	
	Ceratopogonidae					

TOTAL 217

Biologist C Key Total Number of Taxa 12 $\bar{d} = 2.53$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ion No. F-4 Sample No. 1 Sampling Method Surber Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	2	1
		Rhithrogena	*undulata*		6
	Baetidae	*Baetis*	*bicaudatus*		15
		Callibaetis			
		Pseudocloeon		1	
		Ephemerella			
		Trichorythodes	*minutus*	13	36
		Lachlania			
		Traverella	*albertana*	~~75~~ 16	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		1	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae			3	
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
?	2 Tipulidae	~~Hexatoma (?)~~		2	

TOTAL 38

Biologist

Total Number of Taxa ~~8~~ 7

$\bar{d} = 2.07$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ion No. F-4 Sample No. 2 Sampling Method Surber Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	2	1
		Rhithrogena	*undulata*	7	6
	Baetidae	*Baetis*	*bicaudatus*		15
		Callibaetis			
		Ephemerella			
		Trichorythodes	*minutus*		36
		Lachlania			
		Traverella	*albertana*	5	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*	1	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*		1	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*			
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
			TOTAL	16	

Biologist CPerry Total Number of Taxa 5

$\bar{d} = 1.92$

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

tion No. F-4 Sample No. 3 Sampling Method SURBER Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	5	1
		Rhithrogena	*undulata* ✓	10	6
	Baetidae	*Baetis*	~~*bicaudatus*~~	~~1~~	15
		PSEUdocloEON	turbidum	2	
		Callibaetis			
		DAchtylobAETis	✓	1	
		Ephemerella			
		Trichorythodes	*minutus*		36
		Lachlania	✓	1	
		Traverella	*albertana* ✓	13	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
coptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*			
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
			TOTAL	32	

Biologist Clay

Total Number of Taxa 7

Dall-mayfly

$\bar{d} = 2.03$

[illegible]

eptagena elegantula 23 mm — Not used

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ion No. F-4 Sample No. 4 Sampling Method SURBER Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES		NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	~~20~~24	24	1
		Rhithrogena	*undulata*	4	4	6
		STENONEMA (?)			~~2~~1	
	Baetidae	*Baetis*	*bicaudatus*			15
		PSEUDOCLOEON *Callibaetis*		~~2~~9	9	
		Ephemerella		1	1	
		Trichorythodes	*minutus*	(?)	1	36
		Lachlania				
		Traverella	*albertana*	5	4	27
Odonata	Gomphidae	*Gomphus*	*intricatus*			43
		Ophiogomphus	*severus*			45
	Libellulidae					
	Aeschnidae					
optera	Perlodidae	*Isogenus* *Arcynopteryx*				
	Perlidae	*Taenionema*	*pacifica*			65
		Acroneuria				
Trichoptera	Hydropsychidae	*Hydropsyche*				
	Limnephilidae					
	Brachycentridae	*Brachycentrus*				
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*			81
	Gerridae					
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae					
Diptera	Simuliidae		PUPA		1	
	Culicidae					
	Chironomidae	UNIDENT			1	
		Chironomus			1	
	Ceratopogonidae					
			TOTAL		47	

Biologist C Pa Total Number of Taxa 10

Collected at upper end of bar 175± meters

taken on [illegible]

NO Rhithrogena - [illegible] ✓
list as 4 on summary sheet

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

ion No. F-4 Sample No. 6 Sampling Method Surb Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 61	61	1
		Rhithrogena	*undulata*	0 NOTE	6
	Baetidae	*Baetis* ~~Sp.~~	~~*bicaudatus* 47~~	~~42~~	15
		Sp.	B1	1	
		Callibaetis			
		Dactylobaetis	~~[illegible]~~ + 5	5	
		Ephemerella			
		Pseudocloeon	turbidum	42	
		Trichorythodes	*minutus*		36
		Lachlania			
		Traverella	*albertana* 23	23	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus* 2	2	45
		Hetaerina		1	
	Libellulidae				
	Aeschnidae				
ptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	7	7	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
	Leptoceridae	Leptocella	5	5	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae			7 2	
	Ceratopogonidae				

TOTAL 149

Biologist CRay Total Number of Taxa 10

d=2.23 ~~[illegible]~~

List on summary as 5

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-1

Station No. F-4 Sample No. 7 Sampling Method SURBER Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula* 45+6+2+1	~~45~~ 59	1
		Rhithrogena	*undulata*		
					6
	Baetidae	*Baetis*	SpA 1+1	2	
					15
		Pseudocloeon	*turbidum* ~~49~~ ~~27~~ 28+1	29	
		Dactylobaetis	*cepheus* 4	~~3~~ 4	
	Ephemerellidae	*Ephemerella*			
	Trichorythidae	*Trichorythodes*	minutus 2	2	
			edmundsi 2	2	36
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*		27
	Leptophlebiidae	*Trauerella*	*albertana* 42+4	46	
		CHOROTERPE	6	~~5~~ 6	43
Odonat	Gomphidae	*Ophiogomphus*	*severus* 3-1	~~3~~ 4	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogen*OIDES	1	1	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*	2	2	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
	LEPTOCERIDAE	LEPTOCELLA	sp 3	3	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae		2	2	
	Ceratopogonidae				
		Limnodrilus	2	2	

many empty Leptocella cases.

TOTAL 164

Biologist C. Fey Total Number of Taxa 14

d̄ = 2.54

appear [illegible] lost thru mesh.

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

Station No. F-4 Sample No. 1 Sampling Method Screen Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagenia*	*elegantula* ✓	31	1
		Rhithrogena	*undulata* ✓	2	
					6
	Baetidae	*Baetis*	sp (2 tails	13	
					15
		Pseudoclueon	*turbidum*		
		Dactylobaetis	*cepheus* ✓		
	Ephemerellidae	*Ephemerella* ✓		2	
	Trichorythidae	*Trichorythodes* ✓	23	24	
					36
	Oligoneuriidae	*Lachlania*	*saskatchewanensis*		27
	Leptophlebiidae	*Trayerella*	*albertana* ✓ 58	54	
		Choroterpes		1	
					43
Odonata	Gomphidae	*Ophiogomphus*	*severus* ✓	8 all small	45
	Libellulidae				
	Aeschnidae				
	Agrionidae	Hetaerina	sp ✓ (only 1)	1	
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taeniopteryx*	*pacifica*		65
		Acroneuria	abnormis ✓ (only 1)		
Trichoptera	Hydropsychidae	*Hydropsyche*	✓	18	
	Hydroptilidae		✓	1	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*	✓	1	
	Leptoceridae	Leptocella	✓	5	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae	Zaitzevia *(?)	✓	3	
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
	Ephydridae			3	
			TOTAL	170	

* overall 2± cm

Biologist Clay Total Number of Taxa 17

Lachlania? [illegible]-emergence over?

Qual only

MACROINVERTEBRATE LAB WORKSHEET

Project NO. L

tion No. E-5 Sample No. 2 Sampling Method SCREEN Collection Date IX-30-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	**Heptageniidae**	*Heptagena*	*elegantula*		1
		Rhithrogena	*undulata* ✓		6
	Baetidae	*Baetis*	~~*bicaudatus*~~ ✓		15
		Callibaetis			
		Ephemerella			
		Trichorythodes [illegible]	~~*minutus*~~ ✓		36
		Lachlania	✓		
		Traverella	*albertana* ✓		27
Odonata	**Gomphidae**	*Gomphus*	*intricatus*		43
	large	*Ophiogomphus*	*severus* ✓		45
	Libellulidae				
	Aeschnidae				
optera	**Perlodidae**	*Isogenus*/oides	✓		
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	**Hydropsychidae**	*Hydropsyche*	✓++		
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	**Mesoveliidae**	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	**Dytiscidae**	*Agabus*			
	Elmidae				
Diptera	**Simuliidae**				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
			TOTAL		

Biologist ______ **Total Number of Taxa** ______

Sample from meander

Listed as S-1 on Summary

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517

Station No. F-5 Sample No. 2 Sampling Method SURBER Collection Date IX-24-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	Heptagena	elegantula ~~||||~~	6	1
		Rhithrogena	undulata /	1	6
	Baetidae	Baetis [illegible]	bicaudatus |||	3	15
		DActylobAetis	||	2	
		Callibaetis			
		Ephemerella			
		Trichorythodes	~~minutus~~ /	1	36
		Lachlania			
		Traverella	albertana 12	12	27
		ChoroTERPES	AlbiAnnulata	1	
Odonata	Gomphidae	Gomphus	intricatus		43
		Ophiogomphus	severus 2 small	2	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	IsogenOIDES	FRontalis	5	
		Arcynopteryx			
	Perlidae	Taenionema	pacifica		65
		Acroneuria			
Trichoptera	Hydropsychidae	Hydropsyche			
	Limnephilidae				
	Brachycentridae	Brachycentrus			
Hemiptera	Mesoveliidae	Mesovelia	mulsanti		81
	Gerridae				
Coleoptera	Dytiscidae	Agabus			
	Elmidae				
Diptera	Simuliidae		1	1	
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
			TOTAL	~~22~~ 34	

Biologist Clay Total Number of Taxa ~~8~~ 10

Collected from meander $\bar{d} = 2.77$

Fistclas Zon [illegible]

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1577

Station No. E-5 Sample No. 3 Sampling Method SURBER Collection Date IX-30-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 11	11	1
		Rhithrogena	*undulata* 1	1	6
	Baetidae	~~*Baetis*~~ PSEUDOCLOEON	~~*bicaudatus*~~ 13	13	15
		Callibaetis			
		Ephemerella	1	1	
		Trichorythodes	~~*minutus*~~ edmundsi	1	36
		Lachlania			
		Traverella	*albertana* 6		27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*		45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		5	
		LEPTOCELLA		5	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				
	EPHYDRIDAE			1	

TOTAL 38

Biologist Total Number of Taxa 8

collected in meander $\bar{d} = 2.37$

Listed as 3 on summary table

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 15174

Station No. F-5 Sample No. (4) Sampling Method SURBER Collection Date IX-30-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula* 104	104	1
		Rhithrogena	*undulata* 3	3	6
	Baetidae	*Baetis*	*bicaudatus* 6	6	15
		Callibaetis			
		Ephemerella	11	2	
		Trichorythodes	*minutus*		30
		Lachlania			
		Traverella	*albertana* 65	65	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus* 1	1	45
	Libellulidae				
	Aeschnidae				
Plecoptera	Perlodidae	*Isogenoides*	4	4	
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae '|''	*Hydropsyche*	7	7	
	'Limnephilidae'				
	Brachycentridae	*Brachycentrus*	1	1	
		LEPTOCELLA	1	1	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae		Pupa	1	
	Ceratopogonidae				

TOTAL 195

Biologist Total Number of Taxa 11 $\bar{d} = 1.77$

collected at bank opposite lower end of meander

[illegible]

& Pseudocloeon removed

Listed as 4 on Summary table

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1517-17

tion No. F-5 Sample No. (5) Sampling Method SURBER Collection Date IX-30-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE		4	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	54	54	54	1
		Rhithrogena	*undulata*	7	7	7	6
	Baetidae	*Baetis*	~~*bicaudatus*~~	1	1	1	15
		~~D~~					
		Callibaetis					
		Pseudocloeon		~~2~~ 22	22	22	
		Ephemerella			7	7	
		~~[illegible]~~(?)					
		Trichorythodes	*minutus*	8	8	8	36
		Lachlania			224	224	
		~~227~~ *Traverella*	*albertana*	~~2 227~~ 28			27
Odonata	Gomphidae	*Gomphus*	*intricatus*				43
		Ophiogomphus	*severus*	~~2~~ 3	3	3	45
	Libellulidae						
	Aeschnidae						
optera	Perlodidae	*Isogenus* / Isogenoides		3	3	3	
		Arcynopteryx					
	Perlidae	*Taenionema*	*pacifica*				65
		Acroneuria					
Trichoptera	Hydropsychidae	*Hydropsyche*		7	7	7	
	Limnephilidae						
	Brachycentridae	*Brachycentrus*					
	Leptoceridae	Leptocella		1	1	1	
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*				81
	Gerridae						
Coleoptera	Dytiscidae	*Agabus*					
	Elmidae						
Diptera	Simuliidae						
	Culicidae						
	Chironomidae	* Chironomus			2	2	
					1	1	
	Ceratopogonidae					340	

+ [illegible] in [illegible], [illegible] (?)

TOTAL ~~298~~ 340

Biologist Clay Total Number of Taxa 13

collected on bar inside bend = 1.79

above one well

Listed as S-5 on summary table

MACROINVERTEBRATE LAB WORKSHEET

Project NO. 1217

ion No. F-5 Sample No. (6) Sampling Method Surber Collection Date IX-30-75

ORDER	FAMILY	GENUS	SPECIES	NUMBER IN SAMPLE	CODE NO.
Ephemeroptera	Heptageniidae	*Heptagena*	*elegantula*	21	1
		Rhithrogena	*undulata*	7	6
	Baetidae	*Baetis*	*bicaudatus*		15
		Callibaetis			
		Pseudocloeon		1	
		Ephemerella			
		Trichorythodes	*minutus*	3	36
		Lachlania			
		Traverella	*albertana*	63	27
Odonata	Gomphidae	*Gomphus*	*intricatus*		43
		Ophiogomphus	*severus*	2	45
	Libellulidae				
	Aeschnidae				
ptera	Perlodidae	*Isogenus*			
		Arcynopteryx			
	Perlidae	*Taenionema*	*pacifica*		65
		Acroneuria			
Trichoptera	Hydropsychidae	*Hydropsyche*		1	
	Limnephilidae				
	Brachycentridae	*Brachycentrus*			
Hemiptera	Mesoveliidae	*Mesovelia*	*mulsanti*		81
	Gerridae				
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae				
Diptera	Simuliidae				
	Culicidae				
	Chironomidae				
	Ceratopogonidae				

TOTAL 103

Biologist Ray Total Number of Taxa 7

$\bar{d} = 1.5$ ←

collected on bar above gas well

D. AQUATIC BIOLOGY

5. QUANTITATIVE PLANKTON

50 millimeter strip counts (Enumeration factor ◆ 5)

F-1 Alpha sample #1

50 ml. concentrate

Collected July 20, 1975

Cell #1

Strip	Count
1	23
2	18
3	22
4	11
	74

74X 5= 370 cells / ml. concentrate. .

370 cells / ml. X 50 ml. concentrate = 18,500 cells / 2200 ml. sample, or 8.4 cells / ml. water.

Cell #2

Strip	Count
1	22
2	17
3	16
8	13
	68

68 X 5 = 340 cells / ml. concentrate, or

7.7 cells/ ml. water

Cell #3

~~Strip #3~~	Count
1	25
2	26
3	15
4	24
	90

90 X 5 = 450 cells / ml. concentrate, or
10.2 cells / ml. water

F - 2 Alpha sample # 1 50 ml. concentrate

collected July 23, 1975

Cell # 1

Strip	Count
1	15
2	18
3	14
4	14
	61

61 X 5 = 310 cells / ml/concentrate, or

7 cells / ml. water

Cell # 2

Strtrip	Count
1	14
2	9
3	9
4	13
	45

45 X 5 = 225 cells / ml. concentrate, or

5.1 cells / ml water

Cell # 3

Strip	count
1	12
2	18
3	19
4	17
	66

66 X 5 = 330 cells / ml. concentrate, or

7.5 cells / ml. water

F-3 Alpha sample # 1

56.6 ml concentrate

Collected July 19, 1975

Cell #1

Strip	Count
1	12
2	17
3	20
4	16
	65

65 X 5 = 325 cells / ml. concentrate, or

8.4 cells / ml water

Cell #2

1	25
2	11
3	10
4	22
	68

68 X 5 = 340 cells / ml. concentrate, or

8.7 cells / ml. water

Cell #3

1	17
2	7
3	10
4	13
	47

47 X 5 = 235 cells / ml. concentrate, or

6.0 cells / ml. water

F-4 Alpha sample #3

55 Ml. concentrate

Collected July 24, 1975

Cell # 1

Strip	Count
1	15
2	15
3	17
4	11
	58

58 X 5 = 290 cells / ml. concentrate, or

7.25 cells / ml. water

Cell #2

1	12
2	20
3	9
4	8
	49

49 X 5 = 245 cells / ml. concentrate, or

6.1 cells / ml. water

Cell #3

1	6
2	7
3	11
4	14
	38

38 X 5 = 190 cells / ml . concentrate, or

4.7 cells / ml. water

F-5 Alpha sample #3

85.6 ml concentrate
Collected July 22, 1975

Cell #1

Strip	count
1	6
2	9
3	17
4	9
	41

41 X 5 = 210 cells / ml. concentrate, or

8.2 cells / ml. water

Cell #2

1	8
2	11
3	3
4	13
	35

35 X 5 = 175 cells / ml. concentrate, or

6.8 cells / ml. water

1	10
2	16
3	7
4	11
	44

44 X 5 = 220 cells / ml. concentate or

8.6 cells / ml. water

F- 6 Alpha sample # 1 200 ml concentrate

Cell #1

Strip	Count
1	528
2	749
3	814
4	636
	2727

2727 X 5 = 13, 635 cells / ml. concentrate, or

1240 cells / ml. water

The density of cells (all diatoms) in this sample made further counting impractical. The sample consisted of species of Pleurosigma Navicula, and Synedra , in that approximate order of abundance. Other species were extremely rare in the sample.

PLANKTON

Quantitative plankton analysis was conducted in accordance with Standard Methods for the Examination of Water and Watewater, U.S. Public Helath Service, 13thEd., Section 601D. Plankton was collected with a Wildco alpha type sampler at a depth midway between the bottom and the surface. The material was strained through a # 16 silk bolting cloth and preserved in formalin.

Station F-1 October 10, 1974

Strip counts (50 ~~MM~~ mm^2 each strip)

Strip	count
1	53
2	101
3	229
4	118
total	501

Genera present

Filamentous algae	Diatoms
Cladophora	Cocconeis
Rhizoclonium	Cymbella
Spirogyra	Diatoma
	Navicula
	Surirella
	Gomphonema
	Gyrosigma
	Schroderia setigera

~~Enumeration factor =5~~ ~~501X 5 = 2505 cells/ ml concentr~~ate.

~~25 ml sample X 2505 cells/ ml= 0/2/B 62, 625~~ cells per sample

~~200 2200 ml per original sample~~ 28± cells or filaments per milliliter water.

~~Spirogyra sp. — 10~~ cells/ml. concentrate
others unidentifiable ~~due to dessication~~; 200 cells/ ml. concentrate

Station F-2

strip	Count
1	27
2	11
3	17
4	8
total	63

Genera Present
filamentous algae ~~/Diatoms/~~
Spirogyra sp. 35 cells/ml
Ulothrix sp. 10 cells/ml
Vaucheria sp. 5 cells/ml
~~Diatoms~~
Tabellaria sp. 20 cells/ml
Unidentifiable cells 260/ml

~~Enumeration factor = 5, 63 X 5 = 315 cells/~~ml. ~~315 cells/ml X 50 ml = 15,7~~50 ~~cells per sample (2200 ml sample)~~ 7.2 cells ml water

Station F-3

Strip	Count
1	12
2	11
3	12
4	7
	42

Genera present

Spirogyra the only recognizable organism: about 10 cells/ml. of the concentrated sample.

~~Enumeration factor = 5~~ ~~42 X 5 = 210 cells/ml in concentrate.~~
~~50 ml. sample X 310 cells/ml.~~ → 10, 500 cells/~~in entire~~ 2200 ml. sample: about 5 cells per milliliter water

Station F-4

Strip	Count
1	27
2	17
3	15
4	17
	76

Genera present

Cladophora : 12 cell/ml. concentrate.
Cocconeis : 8 cell/ml. concentrate
Navicula : 3 cell/ml. concentrate

~~Enumeration factor = 5.~~ ~~76 X 5 =~~ 380 cells/ml. concentrate.
~~410~~ 380 cells/ml. ~~X 50 ml. concentrate =~~ ~~20,000~~ 19,000 cells in the sample, or about ~~8.5~~ 8.6 cells per milliliter of water.

Station F-5

Trip	Count
1	22
2	31
3	29
4	27
	109

Enumeration factor = 5. 109 X 5 = 545 cells/ml of concentrate.

50 ml. concentrate X 545 cells/ml. concentrate = 27, 250 cells per entire sample, or 125 cells/ ml. in the original sample.

Genera present

Unidentified	198/ ml.
Cladophora	76/ ml.
Navicula	41/ml.
Spirogyra	41/ ml.
Cocconeis	41/ml.
Cymbella	14/ml.
Surirella	14/ml.
Rhizoclonium	7/ml.
Gyrosigma	7/ml.
Gomphonema	7/ml.
Scroderia setigera	7/ml.
Ceratium	7/ml
Tabellaria	7/ml.

Oc T

Station F-6 (Evacuation Creek)   November 12, 1974

Only qualitative collections were made in Evacuation Creek. Current was inadequate for the use of a Surber sampler; substrate was too coarse to permit proper operation of the Ekman dredge. Insects were handpicked or captured with a hand plankton net.

Agabus sp. Dytiscidae, (Coleoptera) common

Limnophora ~~aqu~~ *aequifrons* (Anthyomiidae, Diptera) abundant

Baetis sp. (Baetidae, Ephemeroptera) abundant

Corixa sp. (Corixidae, Hemiptera) Common

Limnephilidae (Trichoptera) common. These are found only on the submerged undersides of shale ledges.

Culex salinarius (~~Culici~~ Culicidae, Diptera) Common

Callibaetis sp. Common.

Simulium sp. (Simuliidae, Diptera) Abundant

Tabanus sp. (Tabanidae, Diptera) Rare

Station F-6   Evacuation Creek   Algae

The following genera of algae were collected in Evacuation Creek on several dates during October and Novermber, 1974.

Mougeotia
Cocconeis
Ulothrix
Microspora
Zygnema
Cymbella
Stauroneis
Navicula
Merismopedia
Synedra
Diatoma
Euglena

The genera are listed in their approximate order of abundance. Only one, or a few specimens of the last three genera were observed.

F-1 QUANTITATIVE PLANKTON

Collected IV-1-75

Examined IV-7-75 (25 ml concentrate)

50 mm. strip counts (Enumeration factor = 5)

Cell #1	Number
1	60
2	57
3	50
4	43
	210

210 = 1050/ml x 25 ml = 26,250/2200 ml = 12 cells ml.

Cell #2	Number
1	28
2	68
3	40
4	68
	204

1020/ml x 25 ml = 25,500/2200 ml = 11.6 cells/ml

Cell #3	Number
1	20
2	24
3	39
4	25
	108

540/ml x 25 ml = 13,500/2200 ml = 6.1/ml

$\bar{X}$ - 9.9 cells/ml

Genera not noted in algal collections:

Spirulina (subsalsa?)

Gyrosigma sp.

Schroderia setigera

[illegible]-2 QUANTITATIVE PLANKTON

Collected IV-3-75

Examined IV-3-75 (25 ml concentrate)

Cell #1	Number
1	57
2	56
3	49
4	23
	185

925/ml x 25 ml = 23,125 cells/2200 ml = 10.5 cells/ml

Cell #2	Number
1	28
2	57
3	25
4	30
	140

700 cells/ml x 25 ml = 17,500/2200 ml = 8 cells/ml.

Cell #3	Number
1	35
2	65
3	33
4	41
	174

870 cells/ ml x 25 ml = 21,750 cells/ 2200 ml = 9.9 cells/ ml

$\bar{X}$ = 9.95 cells/ml.

F-3 QUANTITATIVE PLANKTON

Collected IV-1-75

Examined IV-7-75 (25 ml concentrate)

Cell #1	Number
1	33
2	23
3	19
4	26
	101

505 cells/ml x 25 ml = 12,625/2200 ml = 5.7 cells/ml

Cell #2	Number
1	22
2	18
3	25
4	16
	81

405 cells/ml x 25 ml = 10,125 cells/2200 ml = 4.6 cells/ml

Cell #3	Number
1	24
2	14
3	14
4	15
	67

335 cells/ml x 25 ml = 8,375 cells/2200 ml = 3.8 cells/ml.

$\bar{X}$ = 4.7 cells/ml

F-4 QUANTITATIVE PLANKTON

Collected IV-2-75

Examined IV-7-75 (50 ml concentrate)

Cell #1	Number
1	24
2	28
3	57
4	34
	143

715 cells/ml x 50 ml = 35,750 cells/2200 ml = 16.2 cells/ml

Cell #2	Number
1	28
2	43
3	65
4	48
	164

820 cells/ml x 50 ml = 41,000 cells/2200 ml = 18.6 cells/ml.

Cell #3	Number
1	53
2	55
3	82
4	67
	257

1285/ml x 50 ml = 64,250 cells/2200 ml = 29.2 cells/ml

$\overline{X}$ = 21.3 cells/ml

tabellaria floculosa present.

F-5 QUANTITATIVE PLANKTON

Collected IV-2-75

Examined IV-7-75 (25 ml concentrate)

Cell #1	Number
1	52
2	60
3	51
4	34
	197

985 cells/ml x 25 ml = 24,625/2200 ml = 11.2 cells/ml

Cell #2	Number
1	56
2	60
3	60
4	45
	221

1105/ml x 25 ml = 27,625/2200 ml = 12.6 cells/ml

Cell #3	Number
1	49
2	61
3	64
4	57
	231

1155 cells/ml x 25 ml = 28,875 cells/2200 ml = 13.1 cells/ml.

$\overline{X}$ = 12.3 cells/ml.

Fish collected from immediately upstream of the Bitter Creek confluence (DWR Station 5), November 20,1975.

No.	Name	Standard Length SL (mm)	Weight grams	Condition factor K_{SL}
1	*Catostomus latipinnis*	298	452	1.71
2	" "	117	36.7	2.29
3	" "	116	24.0	1.54
4	" "	98	17.5	1.86
5	" "	82	13.8	2.50
6-21 (16)	" "	20 (average)	27.7 (total)	----
22-28 (7)	*Pimepheles Promelas*	20 (average)	6.7 (total)	----
29-404 (375)	*Notropis lutrensis*		121.5 (total)	----
405-495 (91)	*Rhinichthys osculus*		97.1 (total)	----
495 total				

Fish collected on leased agricultural area near east boundary of Indian land (DWR Station 6), November 20, 1975.

No.	Name	Standard Length SL (mm)	Weight grams	Condition factor K_{SL}
1	*Cyprinus carpio*	220	416.4	3.9
2	" "	248	672.7	4.4
3	" "	247	712.7	4.7
4	*Gila robusta*	210	186.8	2.02
5	" "	52	2.1	1.50
6	" "	153	62.9	1.75
7	Catostomus latipinnis	186	156.7	2.44
8	" "	57	4.6	2.48
9-15 (7)	*Notropis lutrensis*	53	3.4	3.49
10	" "	46	3.0	3.09
11	" "	34	0.9	2.29
12	" "	32	0.9	2.74
13	" "	35	1.1	2.57
14	" "	33	0.9	2.50
15	" "	24	0.6	4.3
16	Unidentifiable larva (Notropis ?)			

The collection also contained one *Dytiscus ooligbukii*

Fish collected at the Mountain Fuel Supply Bridge (DWR Station 7), November 21, 1975.

No.	Name		SL (mm)	grams	K_{SL}
1	*Catostomus*	*latipinnis*	61	3.8	1.67
2	"	"	51	2.7	2.04
3	"	"	58	3.0	1.54
4	"	"	45	1.3	1.43
5	"	"	33	0.3	0.83
6	"	"	41	0.7	1.89
7	"	"	47	1.4	1.35
8	*Rhinichthys*	*osculus*	64	5.0	1.91
9	"	"	57	3.2	1.73
10	"	"	48	2.1	1.90
11	"	"	45	1.6	1.76
12	"	"	49	1.7	1.44
13	"	"	49	1.6	1.36
14	"	"	52	2.4	1.71
15	"	"	45	1.35	1.48
16	"	"	37	0.45	0.89
17	"	"	45	1.45	1.59
18	"	"	36	0.65	1.39
19	"	"	1.8	0.02	0.34
20-298	*Notropis*	*lutrensis*			

298 total

Notropis lutrensis-- 24 fish selected at random from the above collection

SL (mm)	Wt. (grams)	K_{SL}
29	0.35	1.44
34	0.7	1.78
32	0.6	1.83
29	0.45	1.84
28	0.35	1.59
47	2.0	1.92
32	0.6	1.93
29	0.5	2.05
32	0.6	1.83
37	1.25	2.47
28	0.35	1.59
28	0.4	1.82
22	0.2	1.88
21	0.12	1.94
27	0.35	1.78
25	0.30	1.52
27	0.35	1.78
24	0.32	2.31
27	0.4	2.03
26	0.4	2.26
22	0.25	0.35
24	0.27	1.95
20	0.15	0.63
27	0.22	1.12
$\bar{X}$ = 28.3	$\bar{X}$ = 0.48	$\bar{X}$ = 1.78

Fish collected at White River bridge near Ouray, Utah (DWR Station 8), November 21,1975.

No.	Name	SL (mm)	Grams	K_{SL}
1-157	Notropis lutrensis	-----	---	----
158-161	Cyprinus carpio	-----	---	----
162	Ictalurus punctatus	88	12.2	1.79
163-182	" "	-----	24.0 (total)	---
183	Salmo trutta	88	13.2	1.94
184	Catostomus latipinnis	187	132	2.02
185-201	Rhinichthys osculus		19.4 (total)	---

V. GEOLOGY AND SOILS

V. GEOLOGY AND SOILS - GEOLOGIC EXPLORATION REPORT

WHITE RIVER SHALE PROJECT

GEOLOGICAL INFORMATION SUBMITTED TO VTN FOR THE 5TH QUARTERLY REPORT

DECEMBER, 1975

BY

THE CLEVELAND-CLIFFS IRON COMPANY

W. W. MOULTON

GEOLOGICAL ENGINEER

THE CLEVELAND-CLIFFS IRON COMPANY
WESTERN DIVISION OFFICE

Interoffice Memo

TO: P. W. McKie
Superintendent

COPIES TO:

FROM: W. W. Moulton
Geological Engineer

DATE: December 12, 1975

SUBJECT:

In summarizing the Geologic Exploration Plan in Quarterly Report No. 5, the following information will be made available to V.T.N.

1) Copies of Lithologic Logs.

2) Intervals tested for boron, mercury, cadmium, flouride, antimony, arsenic, selenium, molybdenum and nahcolite with results.

3) Intervals assayed and rock mechanics tested, results not required. — why not? are they done?

4) Approximate location of the mining zone within the bore holes.

5) Uinta-Green River contact pics.

The following sections contain the above material together with test results where required.

Wesley W Moulton
W. W. Moulton
Geological Engineer

WWM/vc
Attachment
12/12/75

THIS TRACE ELEMENT DATA IS VOID. DO NOT USE.

CORRECTED DATA AVAILABLE IN SIXTH QUARTERLY REPORT "FIELD DATA"

RAT

11/

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1) Copies of the original Lithologic Log are included with this report and follow the Uinta-Green River contact pics.

2) Samples from 100 foot intervals from holes X-2, X-3, X-4, X-5, X-6, X-9, X-10, and X-11 were analyzed for boron, mercury, cadmium, flouride, antimony, arsenic selemium and molybdenum. These tests were on samples of raw and spent shale. The samples of spent shale were analyzed for the portion of the elements that are water soluble and the total element contained. Raw shale was analyzed for the total element contained.

All results are in parts per million.

Results for spent shale total element contained. (Note Example X-2, 600 - 700).

HOLE NO.:	X-2	X-3	X-4	X-5	X-6	X-9	X-10	X-11
FOOTAGE INTERVAL TESTED (Feet)	600 -700	430 530	797 897	772 872	642 742	902 1002	932 1032	825 925
Boron	6	0	0	0	0	0	0	0
Mercury	16.6	19.0	22.0	23.0	22.0	20.0	19.0	20.0
Cadmium	0.17	0.16	0.18	0.17	0.20	0.18	0.19	0.19
*Flouride	450.0	105.0	100.0	105.0	105.0	105.0	100.0	450.0
Antimony	3.16	3.07	3.19	3.23	3.45	3.80	4.04	3.92
Arsenic	2	3	5	5	7	0	4	5
Selenium	0.07	0.06	0.055	0.11	0.06	0.06	0	0.04
Molybdenum	1.23	1.35	1.22	1.34	1.26	1.23	1.22	1.30

*Wes Moulton (ccic) told me that "F^- all 10X."
Move all F^- decimals 1 place left

12/15/75

Results for spent shale water soluble elements:

Water Soluble

HOLE NO.:	X-2	X-3	X-4	X-5	X-6	X-9	X-10	X-11
FOOTAGE INTERVAL TESTED (Feet)	600 700	430 530	790 900	770 880	640 760	900 1010	930 1040	820 930
Boron	1.9	3.4	5.2	1.7	3.4	1.4	3.1	4.3
Mercury	1.2	0.9	0.5	0.8	0.6	0.4	0.4	0.09
Cadmium	0.01	0.03	0.02	0.01	0.02	0.01	0.02	0.01
Flouride	85.0	85.0	90.0	92.5	100.0	110.0	25.0	135.0
Antimony	.31	.16	.15	.22	.19	0.57	0.26	0.28
Arsenic	0	5	0	4	4	6	8	1
Selenium	0.01	0.03	0.02	0.02	0.005	0.01	0.03	0.01
Molybdenum	0.68	0.55	0.46	0.50	0.69	0.56	0.69	0.64

Raw Shale Total Element Contained

	HOLE NO.:	X-2	X-3	X-4	X-5	X-6	X-9	X-10	X-11
	FOOTAGE INTERVAL TESTED (Feet)	600 700	430 530	790 900	770 880	640 760	900 1010	930 1040	820 930
Oji File 74-77 70-128	Boron ?	5.2	0	0	0	0	0	0	0
08- 0.15	Mercury 100X	38.0	28.1	25.3	27.5	26.9	22.6	22.3	19.7
<1.0	Cadmium	0.20	0.18	0.17	0.19	0.19	0.17	0.19	0.19
2,100	Flouride 1/10	100.0	115.0	100.0	135.0	150.0	190.0	1400.0	2950.0
1.5	Antimony	3.77	2.29	2.45	2.35	2.08	2.23	2.39	2.35
[illegible]-15	Arsenic 1/10	9	9.0	7.0	7.0	1.0	3.0	5.0	9.0
1-1.5	Selenium 1/10	0.11	0.15	0.10	0.11	0.13	0.15	0.11	0.12
10-20	Molybdenum 1/10	1.44	1.04	0.96	1.24	1.17	0.83	0.97	1.06

Samples from twenty-seven 100 foot intervals in Holes P-1, P-2, P-3, and P-4 were analyzed for boron, mercury, cadmium, flouride, antimony, arsenic and selenium. This analysis was made on raw shale for the total element contained. Results are given in parts per million.

	B	Hg	Cd	F	Sb	As	Se
P-1 HOLE:							
500-600	34.0	0.05	0.03	480.0	0.5	12.0	.26
6- 7	46.0	0.22	0.03	602.0	0.4	16.0	.36
7- 8	29.0	0.12	0.91	1658.0	0.4	10.0	.10
8- 9	6.0	0.12	0.68	1170.0	0.3	5.0	.14
9- 10	13.0	0.16	0.11	644.0	0.6	20.0	.37
10- 11	14.0	0.14	0.11	680.0	0.4	6.0	.27
11- 12	8.0	0.12	0.10	434.0	0.4	29.0	.30
P-2 HOLE:							
550-650	43.0	0.13	0.13	1115.0	0.3	23.0	.08
650-750	49.0	0.10	0.09	704.0	0.4	19.0	.20
750-850	13.0	0.08	0.16	1707.0	0.2	21.0	.26
850-950	28.0	0.08	0.04	319.0	0.4	61.0	.34
950-1050	26.0	0.22	0.04	705.0	0.3	39.0	.24
1050-1150	8.0	0.02	0.11	442.0	0.5	26.0	.20
1150-1250	28.0	0.07	0.08	886.0	0.4	23.0	.35
P-3 HOLE:							
560-670	29.0	0.10	0.19	598.0	0.3	22.0	.14
670-770	28.0	0.06	0.10	648.0	0.2	3.0	.28
770-870	24.0	0.11	0.14	762.0	0.3	15.0	.17
870-970	17.0	0.06	0.12	762.0	0.3	18.0	.20
970-1070	3.0	0.12	0.12	384.0	0.2	27.0	.35
1070-1170	10.0	0.03	0.05	412.0	0.2	11.0	.11

	B	Hg	Cd	F	Sb	As	Se
P-4 HOLE:							
460-560	33.0	0.21	0.14	680.0	0.4	25.0	.10
560-660	42.0	0.12	.09	894.0	0.6	24.0	.15
660-760	23.0	0.14	.13	655.0	0.4	16.0	.93
760-860	16.0	0.04	.08	516.0	0.3	10.0	.35
860-960	13.0	0.03	.11	428.0	0.2	11.0	.80
960-1060	8.0	0.02	.07	320.0	0.3	2.0	.35
1060-1160	7.0	0.03	.09	511.0	0.3	11.0	.23

Extractable alumina analyses on spent shale from the Pilot Test Holes and the Exploration Holes were completed on ten foot intervals. These results, which are attached, are in percent extractable alumina.

Occurrences of nahcolite noted in the drill hole lithologic logs were analyzed for sodium bicarbonate content.

Following are the results of X-ray defraction analyses for nahcolite.

HOLE NO. AND INTERVAL			% NAHCOLITE
P-2 (842.20 - 842.85)	.55	.50	31%
X-11 (837.00 - 837.25)			-0-
X-4 (854.30 - 855.00)	.70	.315	45%
X-4 (853.70 - 854.10)	.40	.14	35%
X-4 (852.68 - 853.50)	.82	.14	17%
X-1 (1073.50 - 1073.75)			-0-
X-2 (661.50 - 663.75)	2.25	.555	38%
	4.72	1.65 = 35%	

[illegible] 5 [illegible]

WHITE RIVER SHALE PROJECT

Extractable Alumina in Spent Shale

HOLE P-1

Footage Interval	% Al
490 - 500	0.320
500 - 510	0.317
510 - 520	0.453
520 - 530	0.598
530 - 540	0.208
540 - 550	0.260
550 - 560	0.265
560 - 570	0.193
570 - 580	0.238
580 - 590	0.008
590 - 600	0.265
600 - 610	0.240
610 - 620	0.227
620 - 630	0.171
630 - 640	0.835
640 - 650	0.198
650 - 660	0.214
660 - 670	0.192
670 - 680	1.500
680 - 690	0.118
690 - 700	0.062
700 - 710	0.063
710 - 720	0.054
720 - 730	0.201
730 - 740	0.201
740 - 750	0.233
750 - 760	0.164
760 - 770	0.173
770 - 780	0.070
780 - 790	0.086
790 - 800	0.132
800 - 810	0.230
810 - 820	0.598
820 - 830	0.978

HOLE P-1 Cont'd.

Footage Interval	% Al
830 - 840	0.874
840 - 850	1.449
850 - 860	1.120
860 - 870	0.938
870 - 880	0.496
880 - 890	0.552
890 - 900	0.757
900 - 910	0.586
910 - 920	0.859
920 - 930	1.210
930 - 940	1.312
940 - 950	1.393
950 - 960	2.058
960 - 970	1.447
970 - 980	1.175
980 - 990	1.274
990 - 1000	1.918
1000 - 1010	1.931
1010 - 1020	2.079
1020 - 1030	2.179
1030 - 1040	2.254
1040 - 1050	-
1050 - 1060	-
1060 - 1070	-
1070 - 1080	-
1080 - 1090	-
1090 - 1100	-
1100 - 1110	0.838
1110 - 1120	1.182
1120 - 1130	1.643
1130 - 1140	1.190
1140 - 1150	0.852
1150 - 1160	1.319
1160 - 1170	1.529
1170 - 1180	1.200

HOLE P-1 Cont'd.

Footage Interval	% Al
1180 - 1190	2.120
1190 - 1200	1.635
1200 - 1210	1.345
1210 - 1220	0.200

$$\begin{array}{r} 5279 \\ 4539 \\ \hline 740' \end{array}$$

MM ≈

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE P-2

Footage Interval	% Al
570 - 580	0.141
580 - 590	0.143
590 - 600	0.141
600 - 610	0.141
610 - 620	0.073
620 - 630	0.098
630 - 640	0.146
640 - 650	0.188
650 - 660	0.214
660 - 670	0.263
670 - 680	0.173
680 - 690	0.193
690 - 700	0.148
700 - 710	0.212
710 - 720	0.154
720 - 730	0.146
730 - 740	0.157
740 - 750	0.200
750 - 760	0.093
760 - 770	0.101
770 - 780	0.090
780 - 790	0.101
790 - 800	0.081
800 - 810	0.170
810 - 820	0.104
820 - 830	0.137
830 - 840	0.080
840 - 850	0.064
850 - 860	0.070
860 - 870	0.081
870 - 880	0.085
880 - 890	0.070
890 - 900	0.095
900 - 910	0.655
910 - 920	0.100
920 - 930	0.177

HOLE P-2 Cont'd.

Footage Interval	% Al
930 - 940	0.161
940 - 950	0.208
950 - 960	0.163
960 - 970	0.120
970 - 980	0.076
980 - 990	0.234
990 - 1000	0.269
1000 - 1010	0.068
1010 - 1020	1.021
1020 - 1030	2.336
1030 - 1040	2.625
1040 - 1050	Lost Core
1050 - 1060	Lost Core
1060 - 1070	1.330
1070 - 1080	2.113
1080 - 1090	0.245
1090 - 1100	0.205
1100 - 1110	2.049
1110 - 1120	2.063
1120 - 1130	2.326
1130 - 1140	2.625
1140 - 1150	2.480
1150 - 1160	0.094
1160 - 1170	0.097
1170 - 1180	1.134
1180 - 1190	0.991
1190 - 1200	0.296
1200 - 1210	0.738
1210 - 1220	2.190
1220 - 1230	1.416
1230 - 1240	1.223
1240 - 1250	1.254
1250 - 1260	1.553
1260 - 1270	1.406
[illegible] - [illegible]	0.177

HOLE P-2 Cont'd.

Footage Interval	% Al
1270 - 1280	0.241
1280 - 1290	1.769

Note: Mahogany Marker at 819 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE P-3

Footage Interval	% Al
540 - 550	0.124
550 - 560	0.098
560 - 570	0.161
570 - 580	0.125
580 - 590	0.147
590 - 600	0.164
600 - 610	0.086
610 - 620	0.114
620 - 630	0.264
630 - 640	-
640 - 650	0.755
650 - 660	0.609
660 - 670	0.283
670 - 680	0.252
680 - 690	0.292
690 - 700	0.894
700 - 710	0.187
710 - 720	0.135
720 - 730	0.782
730 - 740	0.166
740 - 750	0.227
750 - 760	0.152
760 - 770	0.176
770 - 780	0.685
780 - 790	0.253
790 - 800	0.180
800 - 810	0.217
810 - 820	0.124
820 - 830	0.493
830 - 840	0.117
840 - 850	0.166
850 - 860	0.998
860 - 870	0.906

HOLE P-3 Cont'd.

Footage Interval	% Al
870 - 880	0.800
880 - 890	1.406
890 - 900	1.114
900 - 910	0.787
910 - 920	0.991
920 - 930	1.053
930 - 940	0.227
940 - 950	1.264
950 - 960	1.414
960 - 970	1.592
970 - 980	1.468
980 - 990	2.357
990 - 1000	2.591
1000 - 1010	1.944
1010 - 1020	1.570
1020 - 1030	2.264
1030 - 1040	2.862
1040 - 1050	2.783
1050 - 1060	2.070
1060 - 1070	2.340
1070 - 1080	3.016
1080 - 1090	2.657
1090 - 1100	2.025
1100 - 1110	1.060
1110 - 1120	0.907
1120 - 1130	1.378
1130 - 1140	0.735
1140 - 1150	0.866
1150 - 1160	2.268
1160 - 1170	1.754
1170 - 1180	1.411
1180 - 1190	1.613
[illegible] - [illegible]	[illegible]

HOLE P-3 Cont'd.

Footage Interval	% Al
1190 - 1200	1.984
1200 - 1210	1.941
1210 - 1220	2.672

Note: Mahogany Marker at 796 ft.

[illegible] [illegible]

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE P-4

Footage Interval	% Al
450 - 460	0.174
460 - 470	0.574
470 - 480	1.160
480 - 490	0.300
490 - 500	0.921
500 - 510	0.260
510 - 520	0.220
520 - 530	0.779
530 - 540	0.901
540 - 550	0.800
550 - 560	1.196
560 - 570	0.886
570 - 580	0.761
580 - 590	0.822
590 - 600	0.262
600 - 610	0.914
610 - 620	0.804
620 - 630	0.902
630 - 640	1.445
640 - 650	0.241
650 - 660	0.195
660 - 670	0.162
670 - 680	0.107
680 - 690	0.856
690 - 700	0.722
700 - 710	0.516
710 - 720	0.179
720 - 730	0.093
730 - 740	0.290
740 - 750	0.280
750 - 760	0.260
760 - 770	1.057

HOLE P-4 Cont'd.

Footage Interval	% Al
770 - 780	0.816
780 - 790	1.320
790 - 800	1.190
800 - 810	0.792
810 - 820	0.562
820 - 830	1.420
830 - 840	0.973
840 - 850	1.220
850 - 860	0.870
860 - 870	1.870
870 - 880	2.070
880 - 890	1.640
890 - 900	3.000
900 - 910	2.280
910 - 920	2.050
920 - 930	1.317
930 - 940	2.112
940 - 950	2.253
950 - 960	1.763
960 - 970	2.572
970 - 980	2.700
980 - 990	2.949
990 - 1000	1.480
1000 - 1010	1.300
1010 - 1020	1.830
1020 - 1030	1.120
1030 - 1040	0.980
1040 - 1050	1.574
1050 - 1060	1.730
1060 - 1070	1.315
1070 - 1080	1.863
770	[illegible]

HOLE P-4 Cont'd.

Footage Interval	% Al
1080 - 1090	2.250
1090 - 1100	1.580
1100 - 1110	2.700
1110 - 1120	3.300
1120 - 1130	0.682
1130 - 1140	1.191
1140 - 1150	3.000
1150 - 1160	2.635
1160 - 1170	3.300

Note: Mahogany Marker at 703 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-1

Footage Interval	% Al
870 - 880	0.674
880 - 890	0.240
890 - 900	0.223
900 - 910	0.174
910 - 920	0.180
920 - 930	0.209
930 - 940	0.305
940 - 950	0.263
950 - 960	0.431
960 - 970	0.378
970 - 980	0.247
980 - 990	0.548
990 - 1000	0.402
1000 - 1010	0.193
1010 - 1020	0.292
1020 - 1030	0.253
1030 - 1040	0.211
1040 - 1050	0.264
1050 - 1060	0.292
1060 - 1070	0.291
1070 - 1080	0.576
1080 - 1090	0.620
1090 - 1100	0.241
1100 - 1110	0.172
1110 - 1120	0.523
1120 - 1130	0.320

Note: Mahogany Marker at 1003 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-2

Footage Interval	% Al
510 - 520	0.166
520 - 530	0.203
530 - 540	0.221
540 - 550	0.137
550 - 560	0.143
560 - 570	0.934
570 - 580	0.134
580 - 590	0.222
590 - 600	0.120
600 - 610	0.103
610 - 620	0.169
620 - 630	0.259
630 - 640	0.184
640 - 650	0.226
650 - 660	0.124
660 - 670	0.098
670 - 680	0.087
680 - 690	0.076
690 - 700	0.112
700 - 710	0.177
710 - 720	0.214
720 - 730	0.702
730 - 740	0.368
740 - 750	1.017
750 - 760	1.121

Note: Mahogany Marker at 641 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-3

Footage Interval	% Al
330 - 340	0.704
340 - 350	0.308
350 - 360	0.227
360 - 370	0.873
370 - 380	0.249
380 - 390	0.258
390 - 400	0.954
400 - 410	0.157
410 - 420	0.322
420 - 430	0.145
430 - 440	0.101
440 - 450	0.242
450 - 460	1.012
460 - 470	1.012
470 - 480	0.644
480 - 490	0.179
490 - 500	0.143
500 - 510	0.262
510 - 520	0.210
520 - 530	0.756
530 - 540	0.821
540 - 550	1.400
550 - 560	0.696
560 - 570	1.232
570 - 580	0.977
580 - 590	0.956

Note: Mahogany Marker at 470 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-4

Footage Interval	% Al
710 - 720	0.230
720 - 730	0.087
730 - 740	Lost Core
740 - 750	0.548
750 - 760	1.800
760 - 770	0.230
770 - 780	0.330
780 - 790	0.086
790 - 800	0.087
800 - 810	0.130
810 - 820	0.726
820 - 830	0.260
830 - 840	0.264
840 - 850	0.144
850 - 860	0.130
860 - 870	0.108
870 - 880	0.186
880 - 890	0.183
890 - 900	0.312
900 - 910	0.703
910 - 920	0.627
920 - 930	0.617
930 - 940	2.262
940 - 950	1.018

Note: Mahogany Marker at 837 ft.

[illegible] ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-5

Footage Interval	% Al
680 - 690	0.686
690 - 700	1.045
700 - 710	0.619
710 - 720	0.254
720 - 730	1.180
730 - 740	0.246
740 - 750	0.864
750 - 760	0.322
760 - 770	0.195
770 - 780	0.164
780 - 790	0.270
790 - 800	0.591
800 - 810	0.764
810 - 820	0.196
820 - 830	0.109
830 - 840	0.619
840 - 850	0.240
850 - 860	0.590
860 - 870	0.760
870 - 880	0.250
880 - 890	0.994
890 - 900	1.808
900 - 910	1.340
910 - 920	2.700
920 - 930	1.625

Note: Mahogany Marker at 812 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-6

Footage Interval	% Al
540 - 550	0.904
550 - 560	0.570
560 - 570	0.192
570 - 580	0.552
580 - 590	0.300
590 - 600	0.190
600 - 610	1.300
610 - 620	0.300
620 - 630	0.552
630 - 640	0.477
640 - 650	0.313
650 - 660	0.674
660 - 670	0.955
670 - 680	0.812
680 - 690	0.588
690 - 700	0.160
700 - 710	0.090
710 - 720	0.174
720 - 730	0.223
730 - 740	0.894
740 - 750	0.228
750 - 760	1.407
760 - 770	1.220
770 - 780	1.180
780 - 790	1.521
790 - 800	0.844

Note: Mahogany Marker at 682 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-9

Footage Interval	% Al
810 - 820	0.251
820 - 830	0.572
830 - 840	0.300
840 - 850	0.160
850 - 860	-
860 - 870	-
870 - 880	-
880 - 890	0.113
890 - 900	0.162
900 - 910	0.576
910 - 920	0.287
920 - 930	0.275
930 - 940	0.217
940 - 950	0.191
950 - 960	0.228
960 - 970	0.140
970 - 980	0.182
980 - 990	0.280
990 - 1000	0.290
1000 - 1010	1.205
1010 - 1020	0.807
1020 - 1030	1.204

Note: Mahogany Marker at 944 ft.

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-10

Footage Interval	% Al
840 - 850	0.818
850 - 860	0.917
860 - 870	0.262
870 - 880	0.740
880 - 890	0.191
890 - 900	0.207
900 - 910	0.259
910 - 920	1.320
920 - 930	0.252
930 - 940	0.243
940 - 950	0.193
950 - 960	0.836
960 - 970	0.206
970 - 980	0.180
980 - 990	0.176
990 - 1000	0.170
1000 - 1010	0.104
1010 - 1020	0.130
1020 - 1030	0.187
1030 - 1040	0.214
1040 - 1050	0.825
1050 - 1060	0.285
1060 - 1070	0.755
1070 - 1080	0.258
1080 - 1090	0.298
1090 - 1100	1.206

Note: Mahogany Marker at 972 ft.

7

WHITE RIVER SHALE PROJECT
Extractable Alumina in Spent Shale

HOLE X-11

Footage Interval	% Al
730 - 740	0.815
740 - 750	0.804
750 - 760	0.908
760 - 770	0.704
770 - 780	0.645
780 - 790	0.831
790 - 800	1.470
800 - 810	0.220
810 - 820	0.564
820 - 830	0.234
830 - 840	0.282
840 - 850	0.668
850 - 860	0.557
860 - 870	0.216
870 - 880	0.243
880 - 890	0.172
890 - 900	0.197
900 - 910	0.136
910 - 920	0.160
920 - 930	0.199
930 - 940	0.295
940 - 950	0.970
950 - 960	1.592
960 - 970	0.833
970 - 980	0.861
980 - 990	0.936

Note: Mahogany Marker at 866 ft.

3) Footage intervals assayed and rock mechanics tested are as follows:

HOLE NO.:	P-1	P-2	P-3	P-4	X-1	X-2	X-3
FOOTAGE:	676-677	751-752	731-732	672.6 - 673.6	978-979	607-608	438-439
	677-678	752-753	732-733	673.6 - 674.6	979-980	608-609	439-440
	678-679	753-754	733-734	674.6 - 675.4	980-981	609-610	440-441
	685-686	763-764	740-741	680.7 - 681.7	987-988	616-617	441-442
	686-687	764-765	741-742	681.7 - 682.7	988-989	617-618	442-443
	687-688	765-766	742-743	682.7 - 683.7	989-990	618-619	443-444
	697-698	772-773	752-753	692.6 - 693.6	996-997	625-626	450-451
	698-699	773-774	753-754	693.6 - 694.6	997-998	626-627	451-452
	699-700	774-775	754-755	694.6 - 695.6	998-999	627-628	452-453
	706-707	781-782	761-762	701.6 - 702.6	1005-1006	637-638	459-460
	707-708	782-783	762-763	702.6 - 703.6	1006-1007	638-639	460-461
	708-709	783-784	763-764	703.6 - 704.6	1007-1008	639-640	461-462
	715-716	793-794	770-771	710.5 - 711.5	1014-1015	646-647	471-472
	716-717	794-795	771-772	711.5 - 712.5	1015-1016	647-648	472-473
	717-718	795-796	772-773	712.5 - 713.5	1016-1017	648-649	473-474
	727-728	802-803	782-783	722.7 - 723.7	1023-1024	655-656	489-490
	728-729	803-804	783-784	723.7 - 724.7	1024-1025	656-657	490-491
	729-730	804-805	784-785	724.7 - 725.7	1025-1026	657-658	491-492
	736-737	811-812	791-792	731.7 - 732.7	1032-1033	667-668	498-499
	737-738	812-813	792-793	732.7 - 733.7	1033-1034	668-669	499-500
	738-739	813-814	793-794	733.7 - 734.8	1034-1035	669-670	500-501
	745-746	823-824	800-801	740.7 - 741.7	1041-1042	676-677	507-508
	746-747	824-825	801-802	741.7 - 742.7	1042-1043	677-678	508-509
	747-748	825-826	802-803	742.7 - 743.7	1043-1044	678-679	509-510
	757-758	832-833	812-813	752.7 - 753.7	1050-1051	685-686	513-514
	758-759	833-834	813-814	753.7 - 754.7	1051-1052	686-687	514-515
	759-760	834-835	814-815	754.7 - 755.7	1052-1053	687-688	515-516
	766-767	841-842	821-822	761.7 - 762.7	1059-1060	691-692	522-523
	767-768	842-843	822-823	762.7 - 763.7	1060-1061	692-693	523-524
	768-769	843-844	823-824	763.7 - 764.7	1061-1062	693-694	524-525
	775-776	853-854	830-831				
	776-777	854-855	831-832				
	777-778	855-856	832-833				
	787-788	862-863	842-843				
	788-789	863-864	843-844				
	789-790	864-865	844-845				
	796-797	871-872	851-852				
	797-798	872-873	852-853				
	798-799	873-874	853-854				
	805-806	883-884	860-861				
	806-807	884-885	861-862				
	807-808	885-886	862-863				
	817-818						
	818-819						
	819-820						

need thickness of
mining zone for
each borehole?

HOLE NO.:	X-4	X-5	X-6	X-9	X-10	X-11
FOOTAGE:	810-811	789-790	651-652	933-934	942-943	835-836
	811-812	790-791	652-653	934-935	943-944	836-837
	812-813	791-792	653-654	935-936	944-945	837-838
	819-820	798-799	663-664	942-943	954-955	847-848
	820-821	799-800	664-665	943-944	955-956	848-849
	821-822	800-801	665-666	944-945	956-957	849-850
	831-832	807-808	672-673	951-952	963-964	856-857
	832-833	808-809	673-674	952-953	964-965	857-858
	833-834	809-810	674-675	953-954	965-966	858-859
	840-841	819-820	681-682	963-964	972-973	865-866
	841-842	820-821	682-683	964-965	973-974	866-867
	842-843	821-822	683-684	965-966	974-975	867-868
	849-850	828-829	690-691	972-973	981-982	877-878
	850-851	829-830	691-692	973-974	982-983	878-879
	851-852	830-831	692-693	974-975	983-984	879-880
	861-862	837-838	702-703	981-982	993-994	886-887
	862-863	838-839	703-704	982-983	994-995	887-888
	863-864	839-840	704-705	983-984	995-996	888-889
	870-871	846-847	711-712	993-994	1002-1003	895-896
	871-872	847-848	712-713	994-995	1003-1004	896-897
	872-873	848-849	713-714	995-996	1004-1005	897-898
	879-880	855-856	720-721	1002-1003	1011-1012	907-908
	880-881	856-857	721-722	1003-1004	1012-1013	908-909
	881-882	857-858	722-723	1004-1005	1013-1014	909-910
	891-892	864-865	732-734	1011-1012	1023-1024	916-917
	892-893	865-866	734-735	1012-1013	1024-1025	917-918
	893-894	866-867	741-742	1013-1014	1025-1026	918-919
	900-901	873-874	742-743	1023-1024	1032-1033	925-926
	901-902	874-875	743-744	1024-1025	1033-1034	926-927
	902-903	875-876		1025-1026	1034-1035	927-928

4) Approximate location of the mining zone with the bore holes is located with respect to the Mahogany Marker location. The roof will be located on a natural parting plane 20 to 25 feet above the marker. The floor will also be located on a parting plane 35 to 40 feet below the marker. The final choice for a roof and floor location has not been made at this time.

5) The conformable contact between the Unita formation and the underlying Green River formation is usually undulatory and often not clearly defined. This is due to lithologic transitional changes. The Uinta formation consists mainly of sandstones and siltstones, whereas the Green River formation is basically shales and marlstones. The contact was picked from the Geologist's lithologic descriptions and by studying the geophysical logs, mainly the density, resistivity, calipher, natural gamma-ray logs and the density trace of the kerogen analysis log. ? The following contact locations were taken from the Geological Exploration Report.

P-1	199 Feet
P-2	370 "
P-3	265 "
P-4	180 "
X-1	470 "
X-2	104 "
X-3	-
X-4	299 "
X-5	324 "
X-6	185 "
X-9	413 "
X-10	396 "
X-11	335 "

WWM/vc
12/12/75

WHITE RIVER – Ua/Ub

P.1 (Cont) 1 / 7 3 OCT 74 E.C. GENTZLER

AFTER W.R. [illegible]

615	+130	None	100%	Oil Shale – Gray to dk Gray, silty calc., hard v. thinly-bedded. Bedding well developed. Occ thin beds of dk material; hard, non-calc. v.f grd to silt.
616	129		100%	
617	128			
618	127			
619	126			
620	+125			Black, Strong Sulfur odor
621	124			
622	123			Argillaceous Limestone – shaly, lt.-dk gray
623	122			
624	121			
625	+120			
626	119			
627	118			
628	117			
629	116			Shale, gy-dk gy, hard, slightly silty
630	+115			Shale, sandy, dk gray-dk reddish gy, lam thinly bedded
631	114			
632	113			
633	112			Shale as above with thin stringers of coarser material grading to fine sand
634	111			
635	+110			
636	109			Shale, gy-dk gy, silty, hard-thinly bdd.
637	108			
638	107			
639	106			
640	+105			SS, tuffaceous?
641	104			
642	103			Shale, silty, dk gray with some coarser grained material
643	102			
644	101			
645	+100	None	100	Shale, dk gray, mostly silty with black blebs of odoriferous material occurring in thin sandstone lenses
646	99		100	
647	98			
648	97			
649	96			
650	+95			
651	94			
652	93			
653	92			
654	91			
655	+90			
656	89			
657	88			
658	87			
659	86			
660	+85			
661	84			
662	83			
663	82			

EG. HATCHER

~~[illegible]~~ BOE GR CARNAHAN

665	+80	
666		
667	78	1
668	77	NONE
669	76	
670	+75	
671	74	
672	73	
673	72	
674	71	
675	+70	
676	69	
677	68	
678	67	
679	66	
680	+65	
681	64	
682	63	
683	62	
684	61	
685	+60	
686	59	
687	58	
688	57	
689	56	
690	+55	
691	54	
692	53	
693	52	
694	51	
695	+50	
696	49	
697	48	
698	47	
699	46	
700	+45	
701	44	
702	43	
703	42	
704	41	
705	+40	
706	39	
707	38	
708	37	
709	36	
710	+35	
711	34	PP 711
712	33	PP 712.3
713	32	PP 712.6
714	[illegible]	PP [illegible]

100%
100%

12:14 AM 9.30.79

?

¼" tuff SS Shale, dk gy, fine grained (silt or finer) thin bedded with bitumen stains

UPPER WAVY BED - 671'2" (671.17) TO 673'4" (673.33) Tuffaceous SS, distorted bedding white - brownish gray

Shale, dk gray - dk reddish gray, fine grained, hard, thinly bedded

Oil shale, pale brown to dusky brown, homogeneous, thinly bedded

⅛" Tuff SS.

⅛" white, wavy, Tuff. SS.

⅛" tuff SS

⅛" Tuff SS

DK BLK zone, [illegible]

laminae thicker & wavy. Also marked contrast caused by alternation of lt & dk colored bands (laminae)

brn - dk brn oil shale, thinly laminated

light colored buff - lt. brn laminated [illegible] siltstone with thin dark colored streaks - [illegible]

HOLE ___ DATE ___ COLLAR ELEV. ___ TD ___ SHEET ___ OF ___ LOGGED BY E.C. B[illegible]

DEPTH	REL. TO MM	FRAX	PP	ASSAY 10 20 30 40	GAL/TON	LITH.	DESCRIPTION
715	+30	[illegible]	[illegible]				
716	29	[illegible]	[illegible]				
717	28	[illegible]	[illegible]				
718	27	[illegible]					
719	26						
720	+25						[illegible] brown thinly laminated oil shale, medium grade
721	24						
722	23						
723	22						
724	21						
725	+20						brown-dark brown, [illegible], [illegible], laminated, good grade
726	19						
727	18						light brown laminated oil shale with [illegible] irregular laminae & small, irregular [illegible] of tuffaceous ss. – [illegible]
728	17		728.0				
729	16						
730	+15						
731	14						brown - dark brown oil shale, good grade
732	13						
733	12						
734	11						
735	+10		735.5				(irregular break at 0.5" thick tuff layer), mostly medium brown oil shale with variegated very dark brown layers
736	9						
737	8						
738	7						
739	6						
740	+5						
741	4						
742	3						
743	2						
744	+1						
745	0		745.5 745.8				(irregular breaks - 745.5 - 745.9 MAHOGANY MARKER)* 0.40 to 0.45' layer of tuffaceous ss., [illegible]
746	-1						
747	2	•					
748	3		748.8				(irregular break at thin tuff layer)
749	4						
750	-5						
751	6						
752	7						
753	8						
754	9						
755	-10		755.4				(irregular break in 10' tuffaceous ~~[illegible]~~ [illegible])
756	11						
757	12						
758	13						
759	14						[illegible]
760	-15						[illegible]
761	16						[illegible]
762	17		[illegible]				[illegible]
763	18						[illegible]
764	19		[illegible]				[illegible]

30.00' cored (76%)

23' [illegible]

COMMENTS: *Core was pulled at 754 ft. after approx 24 ft was cut - jammed in barrel

HOLE NO. ____ DATE ________ COLLAR ELEV. ________ TD ________ SHEET ____ OF ____ LOGGED BY ______

DEPTH	REL. TO MN	FRAX	PP	ASSAY 10 20 30 40	GAL/TON	LITH.	[illegible]	DESCRIPTION
[illegible]	[illegible]		[illegible]					[illegible]
[illegible]	[illegible]		[illegible]					[illegible]
[illegible]	[illegible]		[illegible]					[illegible]
[illegible]	[illegible]		[illegible]					"OIL SHALE"
[illegible]	[illegible]							[illegible]
[illegible]	[illegible]					<+		[illegible]
[illegible]	[illegible]		[illegible]					
[illegible]	[illegible]		[illegible]					
[illegible]	[illegible]		[illegible]			[illegible]		[illegible] (7??.?–7??.?)
[illegible]	[illegible]		[illegible]			[illegible]		[illegible]
[illegible]	[illegible]		[illegible]			[illegible]		[illegible]
[illegible]	[illegible]		[illegible]			[illegible]		[illegible]
[illegible]	[illegible]		[illegible]			[illegible]		[illegible]
[illegible]			[illegible]					
[illegible]	[illegible]		[illegible]					
[illegible]	[illegible]		[illegible]			[illegible]		[illegible]
[illegible]	[illegible]		[illegible]			[illegible]		[illegible]
[illegible]	[illegible]							
[illegible]	[illegible]		[illegible]					
[illegible]	[illegible]							
[illegible]	[illegible]		[illegible]					[illegible]
[illegible]	[illegible]					[illegible]		[illegible]
[illegible]	[illegible]							
[illegible]	[illegible]		[illegible]					
[illegible]	[illegible]							
[illegible]	[illegible]							brn - dk brn med grade
[illegible]	[illegible]							oil shale
7?2	[illegible]							
[illegible]	[illegible]							
[illegible]	[illegible]							
[illegible]	[illegible]							
[illegible]	[illegible]		796.4					
[illegible]	[illegible]							med - lt brn low grade shale
[illegible]	[illegible]							
[illegible]	[illegible]							
[illegible]	[illegible]							
[illegible]	.6		801.4					
[illegible]	.7		802.? 802.3					
[illegible]	[illegible]		803.6					
[illegible]								
[illegible]	[illegible]							1' irreg layer of ss ([illegible])
[illegible]	[illegible]		806.5					
[illegible]	[illegible]							
[illegible]	[illegible]		[illegible]					
[illegible]								
[illegible]	[illegible]							
[illegible]	[illegible]							
[illegible]	[illegible]		812.0 812.7					3' layer of ss (infill)
[illegible]	[illegible]		812.85					med brn laminated shale
[illegible]								1' irreg layer of ss (infill)

COMMENTS: [illegible]

DATE ______ COLLAR ELEV. ______ TD ______ SHEET ___ OF ___ LOGGED BY ______

DEPTH	REL. TO MX	FRAX	PP	ASSAY 10 20 30 40	GAL/TON	LITH.	DESCRIPTION
815	[illegible]						
816							lt brn low grade shale
817							
818							
819							
820	-18						med grade, [illegible]
821							light tan low grade marlstone
822							(sil[illegible])
823			[illegible]				
824			[illegible]				
825			[illegible]				
826							2' contorted sandy tuff zone*
827	-82						(826.7 to 828.7 - freq. breaks)
828		[illegible]					light tan low grade marlstone
829							
830							
831							
832			832.7				
833							
834							
835							
836			[illegible]				
837			[illegible]				
838			[illegible]				
839							
840							
841							
842							
843							
844							
845							med grade brn oil shale
846			846.2				.2' tuffaceous ss
847			847.2				low to med grade shale
848							med grade shale
849							[illegible]
850	[illegible]						[illegible] formation, [illegible]
851	11.4						
852	[illegible]		[illegible]				[illegible] zone (0.15') [illegible]
853	[illegible]						
854	[illegible]						
855	[illegible]	[illegible]	[illegible]				
856	[illegible]						
857	[illegible]						
858	[illegible]		[illegible]				[illegible] zone [illegible]
859			[illegible]				[illegible]
860	[illegible]	[illegible]	[illegible]				
861							
862			[illegible]				
863							
864			[illegible]				[illegible] (864[illegible])

COMMENTS:

* [illegible], [illegible] soft sediment deformation; contains a few [illegible]

DATE: ______ COLLAR ELEV. ______ TO ______ SHEET 2 OF __ LOGGED BY ______

DEPTH	REL. TOM.?	FRAX	PP	ASSAY 10 20 30 40	GAL/TON		LITH	DESCRIPTION
865	.120		[illegible]					Oil [illegible] (…)
866	[illegible]		[illegible]					
867	.122							
868	.123		868.[illegible]					SHALE - Silt[illegible]
869	.124		869.25					Black in Contact [illegible] laminated [illegible]
870	.125		[illegible]				X	and [illegible]
871	.12							[illegible]
872	.12							
873	.12							
874	.1		874.8					
875	.13							
876	.1							
877	.1		877.[illegible]					Tuff [illegible] (…) [illegible]
878	.1							[illegible]
879	.1		879.85					
880	-.13							
881			[illegible]					Sh[illegible] siltstone [illegible]
[illegible]			[illegible]					[illegible]
[illegible]			[illegible]					
[illegible]			[illegible]					[illegible]
[illegible]	.14		[illegible]					[illegible]
[illegible]			[illegible]					k[illegible] Contact
[illegible]			[illegible]					[illegible]
			[illegible]					[illegible]
[illegible]	[illegible]		[illegible]					[illegible]
[illegible]			[illegible]1.4					[illegible]
[illegible]			[illegible]					Bitumen Zone (…)
[illegible]			[illegible]					
[illegible]								
[illegible]	[illegible]							[illegible]
[illegible]			[illegible]					[illegible]
892			[illegible]					TUFF SS. [illegible]
[illegible]								[illegible] (897.3 - 897.35)
[illegible]								
[illegible]	[illegible]							
[illegible]								[illegible]
[illegible]			[illegible]					[illegible] oil [illegible]
[illegible]			[illegible]					[illegible] (?)
			[illegible]					
[illegible]	-.1[illegible]		[illegible]					SHALE - [illegible]
[illegible]			[illegible]					[illegible] Oil [illegible]
[illegible]								
[illegible]			[illegible]					
[illegible]								
[illegible]	[illegible]							[illegible]
[illegible]			[illegible]					[illegible]
[illegible]								[illegible] ss like [illegible]
[illegible]								[illegible]

DATE ______ COLLAR ELEV. ______ TD ______ SHEET ___ OF ___ LOGGED BY ______

DEPTH	REL TO MM	FRAX	PP	ASSAY 10 20 30 40	GAL/TON	LITH.	[illegible]	DESCRIPTION
915	[illegible]		915.6					
916								
917								
918								
919								
920	-1[illegible]		[illegible]					
921								
922							1411	[illegible]
923			[illegible] [illegible]					shale – siltstone, [illegible]
924			924.7					
925	-1[illegible]							
926			[illegible] [illegible]					
927			[illegible]					
928								Shale, silty, [illegible]
929								[illegible]
930	-165							
931								
932			932.1					
933								
934								
935	-170							
936			[illegible] [illegible]					
937								
938								
939								
940	-175		[illegible]					

MENTS:

CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-2 (CORE) SHEET 1 OF ___ DATE: 21 Oct 74 LOGGED BY: E.C. Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
572								
573								
574								DRILLING CONTRACTOR:
575								ROGER SCHECKE, HENDERSON COLO
								DRILLING RIG:
								FAILING 2500, 12¾ CASING,
								6¾" CHRISTIANSEN "M-21" (?) DIAM. BIT
								DRILLER:
								FRANK GUSTAFSON
								ELEVATION DATUM:
								KELLY BUSHING (5.8' ABOVE LVL G
								[XX] LOST CORE ZONE
								[++] TUFFACEOUS SS
								[==] BITUMEN FLECKS
								[↓↓] Nahcolite (xl aggregates - [illegible])
								[!!] Hematitic flecks, streaks, laminae
								N.B. * The Mahogany Bed was shown @ [illegible] on the W.S.U. γγ density log of P-2 (Pilot). The M.M. was then projected 13' above this (as @ P-1 & Wosco EX-1) but this proved to be erroneous. MM logged @ 825.11 - 825.48. (819.11 - 819.48)
573		45° @ .2	.41			6.39'		~~(Dic)~~ SHALE, med-dk brn; f.-thinly laminated, v. calc., appears to be low to med. grade oil.
574	+245	Vert frx (1.5 x 0.4)	.46			100% - 90%		
575		77° @ .66						
576	[illegible]		.08 .25					
577			.14 .54			21 Oct 74		(?)
578								Tuff SS * (584.05 - 584.19) & (584.25 - 584 "oolitic" texture, [illegible] but core eroded [illegible] in these zones. V. highly calc.
579	+240		.33			10:15 AM		
580			.09 .24			Note ①		
581	[illegible]		.01					
582			.27			489.6'		Tuff Ss (585.21 - 585.53), irreg. upper & lower contact, v. porous, & [illegible]
583						Recovered [illegible] [illegible] Interesting core represents only [illegible] pieces from this [illegible] zone	XX	
584	+235							(The chunks or pieces of core recovered for this zone are of the same Oil Shale but some surfaces have the same Blue gy color that the oil shale horizons develop in weathered outcrops.)
585								
586	[illegible]							
587								
588								
589	+230							One minor Marcasite (?) [illegible] noted in one of these pieces).
590								
591	[illegible]							
592								
593								

Note: 6 ft. has been deducted from these depth measurements because driller measured from top of rotary table

COMMENTS: Core from interval 588.14 - 607.5 was left in hole. (Catcher slipped in shale zones & finally caught on [illegible] 588.2). Driller (Gustafson) did NOT think further needs to be recovered.

THE CLEVELAND-CLIFFS IRON CO. PROJECT: White River Shale Oil / Tract

HOLE NO: P-2 (core) SHEET 2 OF ___ DATE: 21 Oct. 74 LOGGED BY: E.C. Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
594	+225						X	
595							X	
596	~~[illegible]~~						X	
597							X	+++ = TUFF
598							X	*** = Nahcolite
599	+220					1 PM, 21 Oct 74 NOTE ④	X	-:-:- = BITUMEN FLEKS &
600							X	. . = High Grade Zone
601	~~[illegible]~~						X	
602						[illegible]	X	
603						610.14		OIL SH (see description, preceeding page)
604	+215							
605								
606	~~[illegible]~~					101% / 101% RQD		Tuff. SS (612.30-612.37) v.f-grnd, petroliferous, highly
607			.44					irreg lower contact (load cast).
608								(Tuff. lenticular Stringers @ 612.10 & 612.00 & 613.5)
609	+210							
610								
611	~~[illegible]~~							OIL SH W/ TUFF - fine to thinly laminated, med-dk
612							+ + + +	DK Brn low to Mod. grade, w/ many ~~[illegible]~~ v. thin Tuff S. layers
613								(Gradational) contact @ about 618 w/ Oil SH desc above
614	+205					8:10 AM, 22 Oct 74 — 29.84' CUT / ZERO REC 10:30 AM, 22 Oct 74 — PULLED 30.18' NOTE ⑤	+ + + +	V. Calc. Interval 624.5 - 634 also contains tiny
615								v. thin layers of Nahcolite (?) aggregates & tiny-sized
616	~~[illegible]~~						+ + + +	Bitumen lense-lets. Thin interval 636-637 appears to
617								be high grade oil sh & exhibits sl'tly distorted beds.
618							+ + + +	
619	+200		.85				* * * * *	
620							+ + +	Tuff SS. (627.23-627.34), petrolif., diff compacted
621	~~[illegible]~~							~~[illegible]~~ upper surface, lower shows load cast distortion. ~~[illegible]~~ (rel. soft & non-calc)
622							* * * * *	
623								Tuff. Ss (629.48-629.60), f-grnd, petroliferous
624	+195						+ + + +	irreg upper & lower contacts & some SH
625							+ + +	inclusions. Bedding in SH. ~~[illegible]~~ only sl'tly distorted
626	~~[illegible]~~						+ + +	above & below this zone. ~~Some~~
627								Tuff. rel. soft ~~[illegible]~~ & non-calc.
628							+ + +	
629	+190						* * * * *	
630								
631	~~[illegible]~~						+ + +	
632								Tuff. Ss. (638.8-639) v.f-grnd, extremely rich
633							+ + +	in oil & bleeding gas, zone actually consists of
634	+185					640.34	* + * + *	several Tuff. Ss lenses, v irreg & most interbedded
635							* + * + *	w/ the sh.
636	~~[illegible]~~						+ + +	
637								~~(interbedded [illegible] in Tuff sandstone)~~.
638							+ + +	Tuff SS (645.78-.83), f-grnd, w/ much dead oil
639	+180							& some nahcolite
640							+ + + +	
641	~~[illegible]~~							
642								(~~Marker~~ Horizon (? 645 & 648 · [illegible]
643							+ + + +	[illegible] (645.3)

COMMENTS: ④ [illegible] core barrel [illegible], [illegible] core left in the hole, & then drilled an additional 15 [illegible]; [illegible]. The excess length (31.5') of this interval result of cumulative errors in measurement, resulting from drillers measuring of [illegible] 'stick-up on kelly' (thought to be corrected every [illegible] drill [illegible])

⑤ [illegible] AM 22 Oct 74 - Recovered entire length plus some from previous interval

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-2 (CORE) SHEET 3 OF ___ DATE: 22 Oct 74 LOGGED BY: EC Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
650	+175							(~~Higher~~ Mod Oil yield zone 650-651)
651						98% Rec / 98% RQD	+x+x	*Tuff SS lenses (651.80-.85) ~~[illegible]~~, petrolif. [illegible]
652								
653	[illegible]							
654								
655	+170						+x+x	(Thin layer of Nahcolite agg. @ 655.05)
656							+x+x	
657	[illegible]							
658								
659						4:20 PM, 22 Oct 74 30.58' Cut / 30.15' Rec	+x+x	
660	+165							
661								
662	[illegible]							
663							- -	(Many Bitumen flecks & veinlets)
664							- -	(Mod grade Oil zone 663-664)
665	+160						+x+x	
666							-	
667	[illegible]						-	
668							+x+x	
669								
670	+155					670.92	x x x	No CORE (670.49-670.92) & (671.21-671.2
671							xxxxx	
672	[illegible]						++++++	(Extremely High grade Oil Zone ~~[illegible]~~ (671-67
673								Containing thin (.01-.02) Tuff SS. ([illegible]
674		85° @ .82						med-coarse grd w/ Nahcolite, V. irreg. [illegible]
675	+150						+++++	Tuff SS (675.8), varies from .01-.10' thick
676		Vert Frx 676.29 to 677.0	.29 .22 .09					med-grd, w/ Nahcolite. Very irreg. Contacts
677	[illegible]					NOTE: ④	- -	& Cuts bedding in Shale.
678							-	(High grade Zone [678.5 to 679.5]
679							-	
680	+145						-----	
681								
682	[illegible]						+++++	
683								
684								(High Grade Zone [684.8-685.8]
685	+140					8:30 AM, 23 Oct 74 — 30.15' Cut / 30.19' Rec, 99% Rec / 98% RQD	+++++	Tuff SS. (686.0-686.2), med-grd, saturated w/
686								
687	[illegible]						+++++	dead oil; extremely irreg. lens & interbedded
688								w/ Sh.
689							+++++	
690	+135						+++++	
691							+++++	
692	[illegible]						+++++	
693							+++++	Tuff SS (693.42-.57), med/coarse grd, w/ Nahcol.
694							+++++	& [illegible] oil. Also a thin zone @ 694.? &
695	+130		.61					& 695.05 & irreg contacts on last 2.
696								
697	[illegible]						- -	(High Oil zone 697.6 - ~~[illegible]~~ 699.0)
698							- -	
699								

THE CLEVELAND-CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-2 (CORE) SHEET 4 OF ___ DATE: 23 Oct. 74 LOGGED BY: E.C. GENTZLER COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
694	+125							
695			.07			701.07		
696	[illegible]							
697								
698								(High ~~[illegible]~~ Grade Zone)
699	+120							
700								(707.40-.45)
701	[illegible]						+++++	Tuff Ss ^(707.60-.64) & (705.17-.24); mod-gen
702			.80				+++++	distorted bedding, petroliferous.
703								
704	+115		.96				+++++	Tuff Ss (709.80 - 710.56) much dead oil,
705								~~[illegible]~~. thin, bedded,
706	[illegible]					30.14' CUT / 30.10' REC 99% REC / 99% RQD		slightly distorted shale inclusion at 710.40 (buff
707							+++++	Tuff Ss (713.28 - 713.59), ~~[illegible]~~, no oil,
708								
709	+110							Tuff Ss (716.32 - 716.40) petrolif, distorted be
710							+++++	
711	[illegible]		.26					Tuff Ss (718.05 - 718.29), v. contorted bedding
712							+++++	w/ sh intersets. ~~[illegible]~~, & petrolif
713							+++++	Likewise for (719.10 -.15) & (719.30 -.37) &
714	+105							lens @ 721.3
715								
716	[illegible]						+++++	
717						3:55 PM, 23 OCT 74 NOTE ⑤	+++++	
718							+++++	(726.30-726.49)
719	+100						+++++	Tuff Ss ^(727.71 - 728.05), distorted bedding w
720							+++++	sh. intersets, sltly petrolif. Bed @ (724.4-
721	[illegible]						+++++	724.65) contains ~~[illegible]~~ (?).
722								
723							+++++	
724	+95						+++++	
725						725.23	+++++	Tuff Ss (731.27 - 731.32) & (731.50 -.55)
726	[illegible]						+++++	highly irreg upp & low contacts; Petroliferous.
727						101% REC / 101% RQD	+++++	
728							+++++	Tuff Ss (734.2 -.27), irreg. contacts, petrolif.
729	+90							
730			.30				+++++	Tuff Ss (734.30 -.45), reg upp contact, highly irre
731	[illegible]		.74					lower contact, saturated w/ dead oil & contains
732								~~[illegible]~~ (?) & much Clay.
733								
734	+85							
735								
736	[illegible]							
737			.24			12:45 PM, 24 Oct 74 30.66' CUT / 30.29' REC		
738								
739	+80						+++++	Tuff Ss (745.81-.83) & (74_.91-.96) irreg & all [illegible], Clay & petrolif
740								
741	[illegible]						+++++	(UPPER WAVY BED - Tuff Ss (746.65 - [illegible])
742							+++++	w/ irreg sh layer (747.8-.83) & smaller [illegible]
743								[illegible] bottom. Highly contorted [illegible]

COMMENTS:

THE CLEVELAND CLIFFS IRON CO.   PROJECT: [illegible]

HOLE NO: P-2 (Core) SHEET 5 OF ___ DATE: 24 Oct. 74 LOGGED BY: E.C. Gentiluce COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10	20	30	40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
744	+75										
745											
746	[illegible]										
747											
748											
749	+70										
750											dissemin-
751	[illegible]										(Zone 757-760 Contains numerous v. thin layers
752											& isolated blebs of Hematite!)
753											
754	+65								765.2		(Appears to be v. low grade zone to 767.82)
755											
756	[illegible]										
757											
758											(Hematite layer [oil-like] @ 764.45. Black
759	+60										& limey lenses at same 3 horizons
760											765.15 & 765.35 & all .01 to .02' thick.
761	[illegible]		.82								
762											(765 = 774 ; Cu (?) staining Xing w [illegible]
763											
764	+55										
765											
766	[illegible]										
767											
768											
769	+50										
770											
771	[illegible]										
772			.41								
773											
774	+45										(2 small, white, chalcedony vert. lenses @ 781.3)
775											(V. High grade zone 781.85 = 782.2+)
776	[illegible]										
777											Tuff SS, limey lenses (783.13 = 49) w/ clay
778											& silty partings & v. pisolitic layers
779	+40										@ 781.7 [oolite-like]. v. pisolitic
780											layer 783.74 = .77.
781	[illegible]	.40									(Good grade zone = 783.6 to 786.7 (convergent
782		.45 (visc)									& silty distorted bedding)
783			.22								(Chlorite sh @ pp @ 789.22)
784	+35								784.7		MILLSTONE (?) (789.22 = 794.01), v. f. to f.
785											lt. buff coloured, v. f. to silty calcite v. dk. [illegible]
786	[illegible]										v. thin (cc) vuggy zone filled w/ dendritic, ag
787											white pinkish mineral. Highly fractured laminae &
788			.12 .33								thin n.H. ss layers 792-794.
789	+30										(794.01 - 794.33) Opaque white, gra-
790											nular & Spheroidal Mineral - H?Z.
791	[illegible]		.84								
792											
793	.		.36								

7:00 P.M. 24 OCT 74 — 30.4' CUT / 30.3' REC
100% REC
NOTE (C)

HOLE NO: P2 (CORE) SHEET 6 OF ___ DATE: 25 Oct 74 LOGGED BY: E.C. Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
[illegible]	+25							
[illegible]	[illegible]							
[illegible]	[illegible]							(Med Grade Zone [802.4 – 803.7] distorted
[illegible]								bedding, w/ thin petrolif. tuff ss.
[illegible]								
[illegible]								
799	+20		.20					Tuff Ss (805.00 – 805.35), irreg contacts, V.
800			.52			99% REC	H	Contorted bedding, clay, somewhat petrolif. minor py.
801	[illegible]							([805.35 – 806.52] Zone of Hematite Filled
802			.91					Tuff. Ss layers, lenses, & blebs)
803								Tuff Ss, contorted, Extremely Petrolif (bleeding oil) w
804	+15		.64					clay & nahcolite
805								
806	[illegible]		.86			1210 NOON, 25 OCT 74 30.63' CUT / 30.44' REC		(.19', No Core)
807			.06 .30 ~~.43~~					HIGH GRADE OIL SH (812.86 – 814.4) V. hi
808			.44					grade w/ several thin, tuff ss layer w/ nah
809	+10							aggregates – all oil saturated – MB.??
810								SHALE (815 – ~~820~~ 821), lt. brn to med gn, crossing
811	[illegible]							distinct ~~[illegible]~~ banding, calc & dolo
812			.71					
813								
814	+5							
815								
816	[illegible]					[illegible]		
817								
818							H	
819	0		.19					MAHOGANY MARKER (825.11 – 825.48
820							H	Tuff. Ss interbedded w/ Sh.)
821							H H	
822								one very thin dark colored band of pyritiferous, nahcolite (828.5) (~~Zone of thin~~ layers & ~~[illegible]~~ [illegible])
823							H	
824	−5		.05					
825								
826	[illegible]							
827								
828			.73			8:15 PM, 25 OCT 74 — 31.12' CUT / 30.18' REC 96% REC / % RQD ECG		
829	−10							
830								
831								
832								Burro,
833			.30					Extremely Rich Oil Sh (839.30 – 839.68)
834	−15							
835			.81					MAHOGANY BED Blk, extrem. rich Oil Sh
836		in opp. direc.	20° .22 20° .02					(841.32 – 842.22) which has parting plane
837								contact w/ Massive Nahcolite Zone (842
838			.19 .54					– 843.02) which include V. highly distorted layer
839	−20		.14					of extremely rich Oil Sh.
840						Note: (F)		
841								
842			.70					
843								

COMMENTS: (F) LOGGED @ NIGHT BY TRUCK HEADLIGHTS

THE CLEVELAND CLIFFS IRON CO. PROJECT:

HOLE NO: P-2 (CORE) SHEET 7 OF ___ DATE: 25 OCT 74 LOGGED BY: ECGENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
844	-25							
845								
846						Y: 847.50		
847								(High grade Zone (853.75 - .80))
848			.80					Tuff Ss (854.34-.57) wavy contacts, much nahcolite & silty [illegible]
849	-30							interbedded w/ sh.
850								(High grade Zone [854.50 - 857.75]) w/
851						Note! (8)		w/ a PY {hematite} stringer @ (855.68 - .65), [illegible]
852								w/ tiny nahcolite Xl aggregates (oil saturated) at
853								& Below. Smaller stringers @ 855.71, &
854	-35		.84					numerous others to 858.
855						27.07' Rec		[OIL SH & MARLSTONE] (860.0 - 862.3) light-Med [illegible]
856								& V. calc. ~~grading into siltstone~~
857								[SILTSTONE] (862.3-) v. fine to f. silty limy
858								light to Dk Brn, w/ variable oil content - [illegible]
859	-45					30.26' CUT / 89% REC	satd.	distinctive zones of silt & f. DK, & thin silty
860								limy throughout, & containing minor thin
861								tuff Ss, & hematite. & occ. Nahc Xl layers.
862							c	
863			.36 .37					
864	-50							
865								
866			.49			12:30 PM, 26 Oct 74 ECG		
867								
868								
869	-55							
870								
871								
872								
873								
874	-60	Crystal dried oil						
875								LOST CORE
876								
877						Y: 877.76		Oil SH - V. high grade! [illegible] (884.15'), & (884.25-.32)
878		.25	.149 .76 .20					
879	-65	.27 vert.	.27 .45 .86					
880		.80	~~[illegible]~~ .55 .85 .48			30.22' REC		"Oil SH" : Med, dk Brn, mod. grade, silty calc
881			~~[illegible]~~ .45 ~~[illegible]~~ .71					actually siltstone & occ sandy.
882			.02 .21					
883		.54 vert.	.94 .84 .71 .90					
884	-70	.17	.05 .17 .13			3:00 PM, 26 Oct 74 - 27.72' CUT / 102% REC		Tuff Ss - oil sat.
885		Oil sat.						
886			.04					
887								
888								
889	-75		.72			(9)		(ext. High Grade bed (885.72-.76))
890								
891			.30 .78 .147			ECG		
892								
893		<.154	.87					

COMMENTS: [illegible] up @ beginning of shift - so I ordered new core catcher [illegible] cm.
([illegible] Drilled BY [illegible], [illegible], 0.52' of 3.19' left in hole on [illegible] run recovered.

HOLE NO: P-2 (CORE) SHEET 8 OF ___ DATE: 26 Oct 74 LOGGED BY: EC GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
894	-80							
895								Chalcedony (?) (905.71-.74), v. thin layer,
896								massive, opaque, white.
897								
898								Tuff SS lenses, v. distorted bedding, much marcasite & some oil
899	-85						+ + + +	
900							- - - - -	(beds thicker & stly distorted)
901							+ + + +	(Bleeding oil from Tuff SS @ (908.03-.07))
902			~~.44~~				H H H H	(Hem, py, marcasite layers & lenses)
903		Vert. bleeding oil					+ + + +	
904	-90							
905			.20					
906			.62				- - -	
907			.58 .43			907.46	+ + + +	Tuff SS (.01') @ (913.58) bleeding much oil.
908	-95		.34 .76					
909	[illegible]		.38 .77					
910			.80				-	
911								
912			.37 .88					
913	-100						+ + + +	Tuff SS (919.92-920.10), Thin layers interbedded
914	[illegible]					NOTE (10)	+ + + +	w/ thin layers Sh, petrolif. — some layers bleeding o.
915							H -	d/o @ (920.35-.40)
916								
917								
918	-105						+ + + +	Tuff SS (924.45-.60) bleeding oil & containing
919	[illegible]					1 PM, 27 OCT 74 - 30.07 CUT / 29.99' REC		several thin Nahcolite layers.
920								
921							-	
922			.56				+ + + +	2 thin tuff SS (as above) bleeding oil.
923	-110							
924	[illegible]		.32			100% REC	+ + + +	Tuff SS (930.70-.95) bleeding much oil (& gas); 3 thin
925							- -	such layers between 929.46 & 930.10.
926							- -	
927							- -	MARLSTONE, lt. to med ~~[illegible]~~ brn, v. calc,
928	115						H	(935.95 - 936.6)
929	[illegible]						H	
930			.47			ECG	- -	SILTSTONE & TUFF SS (BLEEDING OIL (936.6-939.
931		4° @ .05 .12 Healed Fr. Hs displacing bedding	.92 .09 .83				+ + + +	Bleeding oil & gas profusely from thin layers &
932							+ + + +	some up to .4' thick)
933								
934	-120						H H H H	SILTSTONE & MARLSTONE, lt to med brn
935							H H H H	
936			.83				+ + + +	
937			.53			937.53	H H H H	
938							H H H H	
939	-125							
940			.22					
941		.52 Vert.	.52 .78 .85					
942								
943		.71						

THE CLEVELAND-CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-2 (core) SHEET 9 OF ___ DATE: 27 Oct 74 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

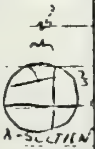
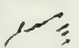
DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
943	-130		.09					
945			.40			7:00 PM, 27 Oct 74 — 30.76' Cut / 30.22' Rec 98% Rec ECG		
953								
957			.48					
952			.25 .45 .73					
949	-135							
950								
951								Tuff Ss (958.00-~~57~~.17), highly Contorted, w/ Sh
952								interbeds & Gilsonite(?) or Bitumin Contorted bags
953								
954	-140							
955								(Some distortion of bedding)
956								
953								
958								
958	-145							
960								Tuff Ss (966.80-.54) w/ much Dahsonite(?)
961								do (967.60-.72) w/ more (?) layers
962		Healed Vert.						(Hematite (?) layer 968.90-.94)
963								Tuff ss (969.55-.70) w/ hematite (?) layer & [illegible]
964	-150							
965								
963								
973						968:		Tuff Ss (973.50-.16), Oil Sat., making gas.
978								
969	-155							LOST CORE
970								Oil SH (976.38-980.7) low to good grade, distorted
971								bedding in upper part (esp. 977.85-.95).
972								Containing thin, white Chalcedony layer & blebs @
973		Vert. .02-.10						978.12, & layer w/ vert. frac (979.02-.10)
974	-160							
975						2 PM, 27 Oct 74, 31.70 Cut / 29.85 Rec 94% Rec ECG 96% RQD		
982								(micro-slumpage in beds @ 982.7)
977								
983			.48					Tuff Ss (983.62-.79) Contorted, [illegible]
985	-165		.17 .46 .13 .79					
980								(Highly colored, finely banded)
981			.66 .89					
985			.67					
988								(do)
989	-170		.63					
985								(Gilsonite (?) layer - 992.51-.52)
976			.11					Tuff Ss (992.88-993.12), Dk, highly altered
983								micro-slumpage in bedding @ 993.4
990			.06					
99[illegible]	-175							
991								(Hi. ratio to oil. Sm)
991								(distorted bedding low grade oil sh)
998								Tuff ss (998.58-999.12), Contorted, [illegible]
		[illegible]	.12					

COMMENTS:

THE CLEVELAND-CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-2 (CORE) SHEET 10 OF ___ DATE: 28 Oct 74 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

994

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
994	-180						++	
995								
996			.34.37				++ +++++	(low to mod grade)
997			.38.41					Tuft 53 (1002.95-1003.2), as above w/ thin (?)
998			.25					buff, v. fine ash (?) layer below.
999	185		.51 .44			999.99		
1000			.91					(Ht brn, f. lamin, calc)
1001			.62 .77					
1002								
1003								(Mod grade zone? distorted bedding)
1004	-190							
1005			.72 .71					
1006								
1007						7:15PM, 28 OCT 74 — ECS NOTE ①	+ +	
1008								(Bitumen (?) ~~zone 1015-1017~~ [1015.07-.11])
1009	195		.20					
1010								
1011								
1012								
1013			.18				+	(Mod grade; highly distorted bedding)
1014	-200					28.86 Cut / 28.10 Rec		
1015								
1016			.20					
1017		X-SECTION						Tuft 5 ß (1024.05-.10), bleeding oil, undulatory lower contact & showing 5 (?) set
1018		Healed vert.	.11					of healed vert. frx. (See X-Section in FRX col.
1019	205						contact	
1020								
1021			.62				+	(Mod-high grade [1023.75-1024.55] & [1024.60-1025.25])
1022								
1023			.10					
1024	210							
1025								
1026			.67					
1027			.35 .42					
1028						1028.35		.76' NO CORE
1029	215							
1030								
1031								
1032								
1033								
1034	220							
1035								
1036								
1037								
1038								
1039	225 -225							

ENTS: Topliwe because of rain.

HOLE NO: P3 (cont) SHEET 1 OF ___ DATE: 24 Oct 74 LOGGED BY: E.C. Gentzler COLLAR: ___ TD: ___

DESCRIPTION DATUM = Groundlevel

DRILLING CONTRACTOR:
LAYNE WESTERN, DENVER, Co

RIG:
FAILING 2500, 12 3/4 CASING
6 3/4" CHRISTIANSEN "MC-20" DIAM. BIT

DRILLERS:
JOHN SIEFERS – TOOL PUSHER
JACK TABOR – NOON & MIDNIGHT
JIM KAVA – MIDNIGHT – NOON

METHOD:
AIR MIST

SERVICE COMPANY:
WESTERN AIR, GRAND JUNCTION
FRANK MACKENDRICK · OPERATOR
RAY HANCOCK · AIR HAND

+++	Tuff. Ss.
***	Nahcolite
-.-	Bitumen Flecks
☐	High Grade Oil Sh
H	Hematite, Py or marcasite layers, lenses, or blebs
G	Gilsmite flecks.

[illegible]1.4

(loss assigned to top where rounded pieces of core occurred)

6:00 PM, 24 OCT 74 — 30.06 CUT / 29.66' REC
% REC / 89% RQD
ECG

594.4

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
[illegible]							xxxxx	
582	+213 [illegible]		.32					OIL SHALE, Med-dk Brn; V.f. laminated, micro to v. low low grade, w. occ. Gilsmite. Only slltly, mod. Calc.
583								
584								
585	+210		.50				++++++	Tuff Ss layers – irreg up & low contacts, poorly sorted w. much clay, petroliferous
586			.30				++++++	
587			.25				++++++	
588			.72					
589								
590	+205	Vert 590.0-591.4						
591			.40			594.4		OIL SHALE med-dk brn – very finely laminated material with a few interspersed zones of denser grained ~~[illegible]~~ siltstone – med to good yield
592	+208		.00					
593								
594		[illegible]	.00					
595	+200		.60					
596								
597								
598			.60					
599			.60					

COMMENTS:

THE CLEVELAND CLIFFS IRON CO. PROJECT: WHITE RIVER SHALE OIL / TRACT C-a

HOLE NO: P-3 (CORE) SHEET 2 OF ___ DATE: 24 Oct 74 LOGGED BY: ~~E C Gentzler~~ E.R. CARNAHAN COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
600	+195					29.85' FT Run 29.85' Recov 100% MIDNITE 10/24-25		
601			.30					
602	+230		.80					
603								
604			.60					
605	+190		.70					Oil Shale as above with some
606			.60					silty layers
607								
608								
609			.00					
610	+185		.60					
611								
612	+220		.50				====	distinct bit, band
613			.20 .60 .60 613.50					
614			.40					
615	+180		.20 .10				====	distinct bit. band
616			.60					
617			.30 .50				+++++	very thin
618			.40					
619			.30					
620	+175		.30					poorly sorted zone
621			.10			621.25		
622	[illegible]		.20			29.79' Run - 29.70' Recov Filled barrel at 5:45 AM - 2 hr rnd trip		OIL SHALE - med grade, silty with
623			.00 .40					thin zones of higher grade material -
624								scattered, very thin ss layers, finely laminated
625	+170		.70					
626			.80					OIL SHALE - med grade - uniform -
627	+205							finely laminated - very thin ss as above
628								
629			.40				+++++	
630	+165							N.B.
631								SUBTRACT 1.0 TO ALL DEPTHS LOGGED BETWEEN
632	+200							630 & 650'. (FUARO initially mis-marked core) per Bill Lund — ecc
633								
634			.90				+++++	~~NOTE ASSAY - ALL FRACTURES HAVE BEEN~~
635	+160		~~.00~~				+++++	~~RECORDED [illegible] BELOW THE DAILY [illegible]~~
636			.20					~~NORMALLY [illegible] 613.5 [illegible]~~
637	+195							FOR INTERVAL 591.4 - 651.4
638								OIL SHALE as above but increased kerogen
639							+++++	content in very localized zones - several thin
640	+155							to very thin ss layers
641							+++++	
642	+190							
643			.00					
644								
645	+150							
646			.20					
647							+++++	
648			.40					localized increase in kerogen content
649			.00				+++++	

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-3 (CRG) SHEET 3 OF ___ DATE: 10/25/74 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
650	+145							OIL SHALE - med grade - with thin ss
651						651.04 Back in B. Hole - 8 AM 10/25	++++	webs & stringers - many fine flecks of bl' material
652	+150						- -	
653							-·-·-·	
654							- -	
655	+140						-	
656							- -	THIN layers & lenses of v.f. gnd Hematite & py. Also
657							H H	occurs as filling fr. in ss @ 658.43 - .49
658							++++	Tuff SS, irreg lenses, petrolif & containing Py & he.
659			.58					(pp @ .58 occurs in thin (x .05') almost indis-
660	+135						- -	tinguishable Marlstone)
661							G -G	
662	+170						- ++	(Zone of thin hematite layers & ~~[illegible]~~
663							H ++	~~[illegible]~~ layering. Also tiny flecks
664							- H	of Bitumen & Gilsonite)
665	+130							
666								
667						30.00' ← 30.00' / 30.00' REC / 100% REC / 100% RQD 12:20 PM 25 OCT 74 ECG	+++	Tuff SS (667.62-.72) & (668.85-669.05) Highly irr
668							++++	contact, much clay, & v. petrolif. Sl. distorted
669							H H	bedding below ea.
670	+125		.10				H	
671								
672	+160							
673								
674								
675	+120						+++	Tuff SS (675.92 - 676.12) & - Saturated w/ dead oil
676								
677							++++	Tuff SS lenses (677.30 .40) & (677.70 - .78)
678								v. irreg, much clay, & petrolif.
679								
680	+115	•	.75				......	(Med to High Oil Grade Zone)
681						681.0 NOTE ① 100% REC / 100% RQD		
682	+6.50	Healed Vert (?)						
683								
684								
685	+110		.74					(Med to high Oil Grade Zone)
686								
687								
688								
89			.75				+++	Tuff Ss (689.42 - .65) V. irreg contacts,
690	+105					7:25 PM, 25 OCT 74 30.00 CUT / 30.03 REC ECG	......	Saturated w/ dead oil!
691							+++	do. SS (691.54 .75) & (691.80 - 692.42)
692	[illegible]	Healed Vert.					+++	w/ some Sh intervals
693							......	
694							......	
695	+100	Healed Vert.					++++	
696							......	
697							......	Tuff Ss (698.05 - .15), as above w/ some Nah.
698			.15				......	
699	•	Healed vert. fr	.86				+++	do (699.60 - 700.30) w/ some sh interbeds

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-3 (CORE) SHEET 4 OF ___ DATE: 25 OCT 74 LOGGED BY: E.C. GENTZLER & E.R. CARNAHAN COLLAR: _____ TD: _____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
700	+95							(Minor hematite bless, & in some tuff ss seam
701								~~Siltstone~~
702	+130							V. finely lam., med brn, in Siltstone & v. uniform, sl silty to med. cole.
703								
704								
705	+90							
706								~~Carbonate~~
707		Healed vert (?)				ECG		Tuff ss. (707.23-.34) as above
708		do!						(708.90-709.08)
709			.08					
710	+85					711.04		
711			.00			30.12' CUT 29.79' Recovery (loss at 717') Finished run at 1:20 AM 10/26		OIL SHALE - brn to dk brn, [illegible]
712	+120		.13					[illegible] some [illegible] hi-grade streaks,
713			CORE LOSS .00					
714			.49					
715	+80							
716								Siltstone, med brn to lt brn -
717			.20					poor grade
718			.58					
719								
720	+75		.50					
721								
722	[illegible]							
723			.30 .45					6" high grade zone - oil shale -
724								
725	+70							UPPER WAVY BC Tuff ss contacts
726			.85					726.[illegible] - 728.50 [illegible] contacts
727			70, .30					Siltstone as above
728			.50					
729								
730	+65							
731			.30					4" high grade zone. oil shale
732								siltstone as above
733								
734								
735	+60		.10					
736			.10 .60					
737								
738			.30					
739			.80					
740	+55							
741			.00			741.16		OIL SHALE, med-dk br
742			.00 .10			STARTED DRILLING 3:25		
743		— 15°						
744								Siltstone, buff colored, very [illegible]
745	+50		.50					narrow hi grade oil shale zone
746			.60					OIL SHALE - med with thin dk brn zones
747			.80					
748								narrow hi grade oil shale zone
749								

COMMENTS:

THE CLEVELAND CLIFFS IRON CO. PROJECT

HOLE NO: P-3 (core) SHEET 5 OF ___ DATE: 10/26/74 LOGGED BY: E.R.C. & E.C.G. COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
750	+45							OIL SHALE, DK BRN
751						29.79 Recov 99% RQD 97.5%		OIL SHALE, MED BRN with scattered thin
752								~~bands of~~ finely laminated dk. brn
753			.80					bands
754								
755	+40		.60					
756			.50					
757								tuff - intermittent inclusions
758								& thin stringers
759			.40 .60					
760	+35		.50			29.88' Cut 7:30 AM 10/26/74		H. Grade Oil Shale in concentrated thin ban
761								OIL SHALE, MED BR, silty
762	~~+30~~		.10 .40					
763			.50				+ + + +	Siltstone, buff to light gray (
764			.10 .40				+ + + +	with a few thin, light brn
765	+30		.50				+ + + +	interbedded shale zones. - Sltst is
766			.60				+ + + +	finely laminated with slightly contorted beddi
767			.20 .50 .40				+ + + +	at 765.5 & 767.4
768			.50					OIL SHALE, finely laminated, med
769			.20			ERC		brn to gray - decreasing Kerogen content
770	+25		.10					Siltstone, light gray
771			.48			771.04		
772	~~+20~~					10:00 AM Begin Drilling		
773			.28					
774								
775	+20							
776								Oil SHALE, dark br - blk, fine lam, sl contorted
777			.58					bedding
778			.12					(Hard, dense, & dolomitic)
779			.29					
780	+15		.65 .60			30.00' CUT / 30.00' REC		Oil SHALE, brn, hard, thinly bedded
781			.50 .12					Tuff SS, contorted bed. & containing dol.
782	~~+10~~	Vert. healed	.43					& much clay.
783			.64 ← along healed cast surface					
784								
785	+10							
786								
787								
788								
789								
790	+5					26 OCT 74		
791								
792	~~+0~~							
793								
794								(& grades into dolo. thin tone w/ hemat. & thin lay.
795	0	Vert healed				3:10 PM		Tuff SS Bx (795.60-796.05), much clay, some o
796			.36			ECG		← [MAHOGANY MARKER E]
797								
798			.15	along healed cast surface				
799			.78 .35					

THE CLEVELAND-CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P3 (core) SHEET 6 OF ___ DATE: 26 Oct 74 LOGGED BY: EC Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
800	-5		.42					
801			.04			801.04		
802	[illegible]							
803			.34					
804			.14					
805	-10		.33					
806								High grade oil sh (807.32-.42)
807			.32					
808								do (808.16-.85) w, ~~[illegible]~~
809								(distorted bedding)
810	-15							
811								
812	[illegible]		.9			1:35 PM, 26 Oct 74 — 30.20' Cut / 28.99 Rec		High grade dk banded zone 811.6 - 812.9
813								~~812.4-813.05 - contorted tuff?~~
814								
815	-20							
816								
817								
818								
819								MAHOGANY [illegible] BED (?)
820	-25		43					Extremely High grade zone (sh - siltstone)
821								→ CORE LOSS
822	[illegible]							
823								
824								
825	-30					ECG		
826								
827								
828								
829								
830	-35							Siltstone, buff with thin dk brn bands
831						831.04		Siltstone, buff to brn (to 839)
832	3							
833								
834								
835	-40					29.95' Cut, [illegible] Recd — started coring 12:40AM [illegible]		
836			~70					
836								
838								
839								
840	-45		.35					Siltstone - silty shale, lt brn to tan
841			.00					with few narrow bands of darker
842			.10					colored shale to 852
843								
844								
845	-50							
846			.30					
847			.40					
848								
849								

ERC ↓

THE CLEVELAND CLIFFS IRON CO. PROJECT: White River Shale Oil Project, C-a & U-b

HOLE NO: P-3 (Cont) SHEET 7 OF ___ DATE: 27 Oct 74 LOGGED BY: E.R. Carnahan, E.C. Gentzler COLLAR: ______ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
850	-55		.20				+++++	
851			.80					
852			.20 .40 .20 .00					Siltstone, buff to tan, banded to 856
853			.10 .20 .10 .95					rubble zone 852.40 - 852.95 (core loss)
854			.55 .00					
855	-60							
856								
857			.10					tuff SS 856.2 to 856.55 = irreg break at t
								~~SILTY SHALE~~, med-brn. to gray
858							+++++	grading to tan siltstone
859			.30					at 860
860	-65		.70					Siltstone, tan, laminated
861			.00 .65			860.86		" with narrow bands of dk brn shale
862						861.74		Hi Grade Shale Zone, dk brn-blk
863			.20					Siltstone, banded, tan -grey
864			.30					
865	-70		.20			Began Drilling 6:40 AM MST 10/27		
866			.00 .90					
867			.00					
868		15°	.55					Hi Grade Oil shale, dk brn-blk
869			.80 .15 .60 .35					869.05 to 870.40 tuffaceous SS - mottled lt. tan brn distorted bedding - uneven. U & L contacts - irreg breaks
870	-75		.10 .40			30.05 Cut, 29.83 Recov'd.		Med grade oil shale
871			.50					banded shale
872			.50					Siltstone, tan to gray, banded
873								to ~~879~~ ~~885.60~~
874			.15 .60					
875	-80		.50					
876								
877			.50					
878								
879			.40					
880	-85							
881			.70					
882			.00					
883								
884			.50					
885	-90		.60 .95					Tuff SS, bleeding oil.
886			.00					SILTSTONE, tan-gray, finely laminated, hard
887			.50					(calc. to dolomitic)
888								~~[illegible]~~
889			.30					
890	-95		.13 .20					
891			.95			891.04		(oil Saturated zone)
892								
893								
894								
895	-100		.96					
896			.06					(Bleeding oil from narrow bands)
897			.37 .08					Marlstone, light gray, hard
898								
899			.84					

COMMENTS: .23' left on Bottom & recovered on following run, etc.

HOLE NO: P-3 (core) SHEET 8 OF ___ DATE: 27 OCT 74 LOGGED BY: E C Gentzler COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10	ASSAY 20	ASSAY 30	ASSAY 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
900	-105		.37								
901									(29.18 from Ka + Run)		(Becoming lt to Med Brn)
902			.87								Marlstone
903											
904											
905	-110										
906			.00								
907			.65								
908											
909			.25						5:00PM, 27 OCT 74 29.18 Cut / 29.37 REC		
910	-115										
911											
912											Marlstone
913											
914			.16 .69								OIL SHALE
915	-120										
916											
917									ECG		
918			.45								(bedding thicker & silty disked)
919									920.22		SILTSTONE, tan-gray, fairly laminated
920	-125										laminated tuff ss
921			.00								" " "
922			.50								
923											laminated tuff ss
924			.40								
925	-130										
926			.30								very dk oily looking siltstone
927			(tbl.) .00								
928									29.64 Recov.		
929											
930	-135		.90								SILTSTONE, A.A.
931											
932			.00								
933											
934											
935	-140		.30								laminated tuff ss
936			.30 .35 .50 .35						29.77 cut,		
937											
938											
939											SILT STONE A A
940	-145		.50								
941			.35								
942											
943	-		.10								tuff ~~ss 943.95~~ – 944.12 gray
944			~.2.								
945	-150										
946			.80								
947			.70								
948											
949			~.35								tuff ss, bedding tilt

HOLE NO: P-3 CORE SHEET 9 OF ___ DATE: 10/26/74 LOGGED BY: EKC COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
950			10 .35 .90			950.19 STARTED DRILLING 1:15 AM 10/26 Cut 29.97', Recov. 29.48'		950-955 Variegated shale, lt. & dk. thin
951			.30					bands – minor bed distortion at 950 94-b
952			.20 .50					
953			00 .70 .85					
954			05 .30 50 .53 .90					
955			(.00 .95)					7 pcs. & .24' core loss between 955.00 & 955.85
956			(.15 .77)					4 pcs. between 956.15 & 956.77
957			.30					955-964.0 banded gray claystone -
958			.40					~~bed dist. slumping at diff compaction~~
959			.40 .60				ŦŦŦŦ	– 2 thin zones of tuffs
960			.00 .20					
961			.75					
962			.50					
963			.25 .75					
964		— 15°	.70					bed dist. slumping at diff compaction
965			.55					964-978 banded gray claystone
966			.40 .55					
967			.55					
968			10 .28 32 .50					
969			.25					
970			10 .70					
971			.85					
972			.90				++++	tar impregnated zone (bleeding) 972.34 - 972.40
973			50 ,90					
974			40 ,90					
975								distorted beds - slumping
976			.10 .50 .80					
977			00 .25 .80					
978			.20 .50 .90					978-980 gray siltstone
979			20 .45 .55					
980			30 .40			980.16 STARTED DRILLING 6:15 AM 10/26 30.0' Run, 28.21' Re-cov.		gray siltstone, very fine, grades
981			.80					to claystone - many fine thin
982			00 .20 30 .40 .75					light & dark bands - moderately uneven
983			55 .43 .90					bedding planes are common - diff compaction
984			.50 .70					
985			.00 .30 .60 .90					
986			.40 .80					Same as above but generally siltier
987			20 .50					more massive zones between bedding pla.
988			00 .35 .50					
989			.70					
990			.10 .40 .80					
991								
992			.20 .65					
993			.70					
994			.30					
995	-20		.20					
996								
997			see note→					997-998, 5 pcs. & redrilled core { 1.5' core loss assigned
998			.40					finely laminated fine siltstone, gray,
999			.30					

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-3 (CORE) SHEET 10 OF ___ DATE: 28 OCT 74 LOGGED BY: E.C. GANNAHAN
E.C. GANTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10	20	30	40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1000	-205		30 .90								
1001			.70								
1002			40 .10								
1003			.50								
1004			40 .80								SHALE, Brn, silty
1005	-210		.10								
1006			.30								
1007			00 .50 60 .90								Siltstone gray – lt brn – buff
1008			.40								finely laminated
1009			35 .55								3 pps from 1008.55 to 1010.0, of coreless assigned
1010	-215								1010.0 STARTED CORING 10:40 AM 10/28		
1011			.08 .77 .37								
1012											Cu SH (1012.34–.55) High Grade lvd
1013			.35 .47								SILTSTONE (1012.55 –), Md-lt Gra, & lam.
1014			.42								
1015	-220		.41								
1016			~~.40~~ .21 34 .55							(1" thn)	Tuff Ss (1015.28–.80), some dead oil
1017			.25 .62 .73 .68	.52 .35	.27						ds (1016.23–.83)
1018			.35								
1019			.10 .67 .45								(lt. brn)
1020	-225		.79						1:30 PM, 28 OCT 74, 30.00' CUT/29.34' REC. ECG		
1021			.58								[illegible]
1022			.18 .31	5.							(Tuff [1022.18–1024.45])
1023			.11								No CORE
1024			.37 .45								
1025	-230		.00								(Gry to brn)
1026			.67								
1027			.13								
1028			.00 .14 .72								
1029			.33								
1030	-235		.11 .91								
1031			.73								
1032			.42								
1033											
1034			.42								
1035	-240		.03								
1036			.08								
1037			.35 .70								
1038											Claystone (1038.56–.60) unstratified, Some
1039									1040.0		[illegible] & Tuff Clay material
1040	-245		.57 .83								
1041											(Gry – lt brn – [illegible] – [illegible] calc. to brn, &
1042			.70								[illegible])
1043											
1044			.07 .71								
1045	-250										
1046			.69								
1047											
1048											
1049											

HOLE NO: P-3 (CORE) SHEET 11 OF ___ DATE: 28 Oct 74 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1050	-255					30.00' CUT / 29.90' REC		
1051								
1052								
1053								Limestone (1053.71 - 1053.80), Buff (to lt gy), thin-
1054								bedded, highly calc., v.f.-grained, with bleeding
1055	-260							oil from several .01' bands between 1053 & 1054.
1056			.18					(Micro-slumpage in bedding @ 1055.5)
1057			.87					
1058								
1059			.85					OIL SHALE, med-dk gray, f.gr., finely laminated;
1060	-265					6:30 PM, 29 OCT 74 ECG		scattered very fine XTALS ~~of marcasite~~ & thin inclusions
1061								of pyrite/marcasite; sulfide occurrence is obviously influenced
1062			.77					by laminated nature of the sediment (to 1064)
1063								
1064								(Buff to lt brn, med. calc.)
1065	-270							
1066			.71 .81					
1067			~~.71 .81~~ .25 .52	.33 .42				
1068								
1069			.14					
1070	-275					1070.26		~~[illegible]~~ ([illegible]-marcasite filling)
1071						(.1' assumed RA on bottom)		
1072								
1073								
1074								
1075	-280							(Marcasite [illegible] layer <.01' thick)
1076								
1077								
1078								
1079								
1080	-285					50.00' CUT / 29.90 REC		
1081			.68 .78					Limestone (1081.68-.78), buff, v.f-gnd
1082								←
1083			.23 .32 .77 .08					(Micro-slumpage [1082.32-.37]
1084			.12 .58 .65					Ls (1084.12-.15) as above, w/ minor sulfides
1085	-290							Siltstone (as above.
1086								
1087			.74					
1088								
1089								
1090	-295		.44			10:45 PM, 29 OCT 74 ECG		
1091								
1092								
1093								
1094								Marc & py stringers & thin layers
1095	-300							Ls (1094.87-1095.21) gy-buff, v.f-gnd [illegible]
1096								
1097								
1098								
1099								

CLEVELAND CLIFFS IRON CO. PROJECT:

HOLE NO: P-4 Core SHEET 1 OF ___ DATE: 10/24/74 LOGGED BY: ERC. COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
						Started out of hole at 4:15 PM 10/23/74		Drill Contractor: Layne-Western G-D 2000
								Drillers:
								Cox, Kauzlarich
								Helpers: Mardirosian, Signorelli
390	(+250) ?						· ° ∘	Siltstone with bitumen blobs
391						391.5	- - ∘	
392						[illegible] 8:30 PM		
393	[illegible]							
394								
395	+245							
396								
397								
398								
399								
400	+240							
401								
402								
403								
404								
405	+235							
406								
407								
408								
409								
410	+2[illegible]		409.9				++++	.1' tuff layer
411								dk brn med to high grade oil shale
412			411.6			20.1/24.0 19.7' recovered Probable core loss at 412'	+++++	thin tuffaceous ss layer w calcite
413	[illegible]	60°						med to low grade laminated, silty shale
414			413.6				+++++	thin tuffaceous ss layer w calcite
415	+225							med-low grade laminated silty shale
416								
417			416.9				- - -	irreg break - very thin dk carbonaceous material ~~[illegible]~~
418			417.6					" " along small blebs (tuff?)
419								silty shale - mostly low grade w med? grade streaks
420	+22[illegible]							
421								
422								
423		90°						
424								slight bedding distortion
425	+215					[illegible] K [illegible] 7:15 AM 10/24	- - -	silty shale - mostly low grade w carbonaceous strk
426								
427							- - -	
428								
429								
430	[illegible]							
431		PP				[illegible]		Silty Shale - low grade thinly laminated oil shale
432		432.38				430.4	/	with carbonaceous (bitumen) flecks
433		[illegible]	[illegible]				· · · ·	moderately calcareous (efforvesc)
434		[illegible]	[illegible]				·	(.01' [illegible] 433.55)

HOLE NO: P.4 (CORE) SHEET 2 OF ___ DATE: 24 OCT. 74 LOGGED BY: ___ COLLAR: ___ TD: ___

WERE OFF BY 1 FOOT & READJUSTED DEPTHS WERE USED ON THIS RUN, PARTING PLANES WERE CORRECTED & ARE THEREFORE IN FRX [illegible] noted!

due to driller's discrepancy - hopefully straightened out from here on - had driller remeasure all rods

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
435	~~[illegible]~~					10:30AM 24 OCT 74 (cut [illegible]) 20.00' CUT / 20.00 RECOVERED RQD=100		Silty Shale (cont')
436		436.14	~~436.23~~					
437		437.8					:	437.8 - 438.6 Sandy Siltstone with small carbonate pods
438			438.05					438.6 - 440.7 slightly higher
439	~~+380~~	439.7(M?)	[illegible]				- .	Carbonaceous content - darker bands
440		440.72					+++-	440.72 → 0.02' tuff. SS (dark coloring may centers by [illegible]
441		441.45	(441.?)				+++	441.45 → 0.03' tuff. SS (although magnetic
442		442.7	[illegible]					(noted with magnet
443	[illegible]							
444			444.0				++++	444.05 → 0.05' tuff SS (")
445	~~[illegible]~~	445.75					- -	
446							- -	
447			447.?5				- -	
448		448.83					- -	
449		449.36						
450	~~[illegible]~~	450.3	[illegible]					
451			451.5			451.4 started cut 12:40 PM 10/24/74		Silty SHALE (CONT') - Red'sh brown generally as above.
452		OTHER BREAKS IN CORE WERE MECHANICAL NOTED IN CORE				RQD=100		451.5 - 451.8 - Sandy Siltstone with small calcium nodules
453	+250		453.3					
454							- -	452.3 - 453.5 higher hydrocarbon content
455	~~650~~		455.05					~~457~~
456								
457								457.1 - 458.1 - Sandy Siltstone with
458			458.15					small calcium nodules
459								458.1 - 458.4 - clay seems - buff colored & less hydrocarbons
460						3:00PM started cut of hole 20.2' RECOVERED/20.1 cut		458.7 - 460.? - darker colored shale has
461								higher hydrocarbon content
462			462.6					462.6 - 463.0 - high hydrocarbon content
463	+240							
464							++++	464.5 → 0.05' of dark SS (tuff?) probable hydrocarbon content
465								
466								
467			467.9					
468			4?6.15					
469							- -	
470						470.5	-	Silty SHALE (CONT') low grade thinly laminated oil shale as above, with bitumen flecks, slightly calcareous
471						Started drilling again at 5:30 PM 10/24/74	- -	
472								472.1 - 475.18 - increased hydrocarbon
473	+230							content throughout in more abundant
474							+++	dark laminations & bitumen flecks
475								474.2 thin (0.05') bed of tuff SS with hydrocarbon bands of higher hydrocarbon
476								
477						16.87' RECOVERED/17.0' CUT RQD=100		475.2 - 482.58 continued silty
478			478.17					Shale, thinly laminated with
479								moderate amount of hydrocarbons
480								increasing lower in interval
481								
482			482.8				++++	482.58 → .82 tuff. SS with bitumen
483	+220							482.82 to 483.6 same as
484								

COMMENTS:

HOLE NO: P-4 CORE SHEET 3 OF ___ DATE: 10/24/74 LOGGED BY: ___________ COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
485						STOP 487.50 PM 10/24/74		483.6-487.14 leaner section of
486								hydrocarbons, occassional
487								bitumen flecks
488						487.14	≡	Mostly med to low grade silty shale -
489			.20			STARTED DRILLING AT 11:15 PM 10/24/74		very hard - conchoidal fracture. -
490								occasional thin high grade zones --
491			.00 .95					thinly laminated - consistent
492								texture & grain size.
493	210						≡	very thin
494							---	
495								
496							---	
497							---	
498								
499						20' Run, 20' Recovery 100%		
500								Similar to above but overall grade
501			.60					appears to be less - no high grade zone
502								
503						15/25		plast frag
504								
505			.20			1:20 AM	+++++	very thin tuff ss - zone of weakness
506			.10				≡	slightly transverse u&L contacts - irreg break @ thin'
507								
508						507.16		OIL SHALE - uniform dk brn - fine
509						Started Drilling 5:00 AM		grained, silty - consistent texture &
510								color
511								
512								
513			~.60					
514								
515		•	~.50			14.99' Run, 20.28' Recov (100%) (core broke off immediately above bit)		
516								
517			~.50				----	OIL SHALE as above but interspersed
518			.70					with numerous thin to very thin, slightly
519			.70					contorted ss. seams
520								
521							≡	.1'ss - irreg u&L bndries - oily
522			.50					
523			.60				≡	
524								
525			.70					
526			.30					
527								
528						527.75		OIL SHALE (still somewhat silty) with
529						START DRILLING 10:15 AM		Numerous very thin SS (tuff?) seams
530							....	throughout. Small clay flecks (<1mm)
531							....	noted thru out section. Grade appears to
532								be increasing. Moderately calcareous.
533								Thin (≈0.01') tuff SS seams - thinner ones also present in section
534		•					....	

ERC

FRB.

THE CLEVELAND-CLIFFS IRON CO. PROJECT: White River Oil Shale (Tracts Ua, Ub)

HOLE NO: P-4 Core SHEET 4 OF ___ DATE: 10/25/74 LOGGED BY: ________ COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10	20	30	40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
535		NOTE: WHERE CORE was Mech Broken by Driller - Fracture gotten on getting core was noted at 541.74 (45° cc) 0.02' of ss at 546.55 (60° cc) 0.03' of ss							Stopped drilling at 11:45 A.M. 10/25/74 20'/20' RECOVERY RQD = 100		Same as above (Oil Shale)
536			536.1								
537											~ tuff ss seams (<0.05')
538											538.25 grade of hydrocarbons drops off below
539											this depth to 542.2
540											542.2 to 543 - higher grade zone
541			541.74								
542											0.1' tuff ss
543			(ss) 543.68							+ + +	543.68 (0.02' of ss)
544											
545											less hydrocarbon material throughout shale
546											still finely laminated with occasional sand seams & clay flecks WHICH Become less abundant below 545.0
547	–								547.15		
548			(ss) 548.5 →						STARTED Drilling 3:15PM 10/25/74 19.83' (recov.)/19.93' (cut) 4:45 P.M. Stopped Drilling RQD = 100		OIL SHALE (SIMILAR to above)
549											still has occasional SS seams
550											& clay flecks - both decrease IN
551											Number by 550.0
552											still finely laminated
553											
554			554.1								
555											higher grade oil shale (approx 1.4')
556											
557											
558											
559											
560			560.7								560.7 - 561.5 higher grade oil shale
561											
562											
563											
564											
565											
566											
567									567.1 Started Drilling 7:10 PM 20.24' recovered/19.93' cut RQD = 100		Oil SHALE (basically silty shale)
568											568.5 finely laminated 569.4 higher grade
569											
570			570.7								569.4 to 575.2 - fairly uniform
571											grade oil shale
572											
573			573.85								
574											
575											high grade (dark color) oil shale
576			576.25							+ + + +	576.1 0.1' tuff ss
577											
578											576.1 to bottom of run fairly uniform
579											medium grade oil shale
580			580.6								
581									Stopped at 9:30PM	+ + +	582.0 (thin tuff ss)
582											
583			583.6							+ + + +	583.6-583.8 tuff ss
584											

OTHER BREAKS IN CORE ARE USUALLY MARKED MB - Meaning Mechanical Break

COMMENTS:

HOLE NO: [-4 Core SHEET 5 OF ___ DATE: 10/25-26/74 LOGGED BY: ___ COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
585							+ + +	Oil Shale (as above.)
586								
587						587.05		OIL SHALE, med grade, uniform.
588						Started at 12:15PM	▤	.1' tuff zone.
589								
590			.80					OIL SHALE, as above, slightly silty
591								
592						10/26		
593			.40					
594								
595								
596			.90			1:35 PM 100%		
597			.70					
598								
599			.10				▤	tuff - 599.3-599.7, break at 599.5 (internal)
600						19.95' Run, 20.02 Recov	▤	~~tuff - break at base.~~
601								plant frags noted
602						Bored/Finished at	▤	OILY tuff zone 602.8-603.15
603								
604								OIL SHALE, med to low grade (subtle chg
605								slight increase in siltiness
606								
607						607.00		OIL SHALE, lt. brn., low grade, very silty
608			.90			4:30 AM	▤	tuff 608.2-608.7, oil saturated
609							▤	thin tuff, oily
610			.30					OIL SHALE as above with considerable
611			irreg .40			Began Drilling		uniformity thruout the run - thin zones of
612			.80					tuffaceous SS appear frequently (these ~~to~~
613								stringers to discontinuous blebs - slightly undulatory
614			.50					contacts)
615								
616			.00			19.85' Run, 19.85' Recov	▤	616.00-616.30 oily tuff
617			.80				▤	617.4-617.8 tuff
618						Bored/Finished at AM		Silty shale, lt brn - low grade
619							▤	thin tuff
620								
621			.10				▤	thin tuff " "
622								
623								
624			~~.~~					
625			.60				▤	.1' tuff - internal break
626								
627			—			626.85		Oil SHALE - Thinly laminated, low to
628	—	—	—		—		—	medium grade, oil shale, with
629	—	—	.10		—	19.58' w/ 19.18 recovered	—	occasional higher grade zones.
630	—	—	—		—	11:00 AM	—	Occasional Tuff SS seams -
631			.85			Started CORING		most prominent are noted (most contain hydrocarbons
632								
633								
634	•						▤	634.25 tuff SS - bleeding hydrocarbons.

COMMENTS:

CLEVELAND CLIFFS IRON CO. PROJECT: WHITE RIVER OIL SHALE (TRACTS Ua & Ub)

HOLE NO: P-4 CORE SHEET 6 OF ___ DATE: 10/26 & 27/74 LOGGED BY: ________ COLLAR: ______ TD: ____

DEPTH (FT)	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
635			~635.0					634.8 to 637.7 – tuff. SS, highly
636			≈ .6 ≈ .8					distorted, easily recognizable, bleeds
637			≈ .15 ≈ .45			RQD = 100		637.7 hydrocarbons in porous patches or
638			.0					WAVY TUFF BED zones. Besides distorted bedding
639			(55) .28					there is a mixture of [illegible]
640								of various sand/silt ratios.
641			.29					639.28 tuff SS (odor) (.03')
642								
643	+(?)		.37			12:45 PM 10/26/74 Barrel Full		Fairly uniform low to medium(?) grade oil shale from bottom of
644			.9					tuff (637.7) to end of run – occasional
645			.26 645.8					SS seams (very thin)
646						646.5		
647						5:25 PM 10/26/74		OIL SHALE (as above) – finely laminated,
648								low to medium grade (except
649								WHERE noted)
650						Started Coring		Very few SS seams now
651								
652								
653	150					14.93 recovered/19.96 cut		653.6 to 660.1 med grade oil Shale
654								
655						RQD = 100		
656								
657								
658								
659								Higher grade material (659.3 to 660.1)
660								
661								
662								
663	)		663.5			7:50 PM Stopped Coring		thin light colored shale immediately above a thin SS seam
664								664.5 to 666.7 higher grade zone
665								with enriched zone from 665.6
666						666.5		to 666.7
667								Oil Shale – brn with thin very dk
668			.05			Started Coring 10:40 PM 10/26/74		brn bands to 669.5 – clayey sms at pp.
669			.00					
670								669.5 to 674.1 banded Siltstone – buff
671			.10 .70					to lt brn, thin clayey sms at parting
672			.40 .60					places – minor distortion of bedding at
673	[illegible]		~.80					673.8 & 675.8 – small vugs at 674.? –
674								some crenulated laminations at 674.7
675			~ .40 .80			17.98 cut 20.28 Rec (core broke to bottom of bit)		
676			.20 .70					Brn silty shale, very uniform to
677								684
678								
679								
680								
681								
682								
683			.10					
684			.10 .19 .10					

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: P-4 CORE SHEET 7 OF ___ DATE: 10/27/74 LOGGED BY: FRC COLLAR: ___ TD: ___

COMMENTS: Mahogany Marker — slightly undulatory contact at the top – more erratic at the bottom
upper zone (.11 to .13') is mottled brn – lower portion is nearly black & dense oily appearance
upp[illegible] ekv of top 6.137'. lower portion contains a few very small (5 mm) partially filled vugs,

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
685			[illegible]					PP darker colored shale
686								685 to 686.9 – shale, med brn with several, thin discontinuous blebs & seams of tuff ss
687			.80			686.9		brn banded (lt-dk) silty shale (687-694)
688			[illegible]					interbedded tuff zones
689			.30			Started coring 3:30 AM 10/27/74		
690			[illegible]					≈ .5' tuff zone
691			.40					≈ tuff zone
692			~~.40~~ .55					
693	+10		.57					
694			.50 .90			20.01' cut, 19.83' Recov.		break within narrow irreg tuff zone break within narrow irreg. tuff zone
695			[illegible]					" " " " " "
696		NOTE: Top of Mahogany Bed showed 4 vert. Fractures starting to develop in high grade, soft, Lt. weight core, only extended into core ≈ 0.05'						694.5 – 702.60 gray to lt. brn silty shale
697								
698			.20 .23					
699								
700								
701			.80					
702	0		.70					
703			[illegible]					MAHOGANY MARKER 702.60 – 703.05 [illegible]
704			.30					[illegible], firm U & L contacts – stairstep break near the top
705			[illegible]					703.05 to end of run – lt brn to gray
706								finely laminated shale
707			.70			706.85		707.3 – tuff ss – bleeding hydrocarbons
708						10. cut 0.15 Recov		**Oil Shale** – finely laminated,
709			.40					low to med. grade
710			.50					
711			711.40			8:45 AM Plugged Core Barrel		3 PP's occur along very thin clay seams
712			.70 .80					
713			.70					
714								
715			.80					716.42 to end of short run 716.97 is very rich, light weight core – Probably top of Mahogany Bed
716			.50					716.42 – Break in core – probable loss of core
717			717.4			716.97		
718						Began coring 3:15 PM		Very Rich Oil Shale, Waxy Feel on Core Surface & Parting Planes
719								719.65
720		4 PP's	to .20 .50					720.2 – med. grade Very Rich, Waxy Feel
721								721.72 721.84 ≈ 0.12' of tuff ss bearing hydrocarbons, It is distorted & Has ALSO DISTORTED SHALE BEDS ABOVE & BELOW IMMEDIATELY
722		NOTE: OTHER BREAKS WERE INDUCED By HAMMER & ARE NOTED ON CORE				Recov. 19.73/20.0 feet (19.23/19.73) RQD 10/27/74		
723								
724								
725			[illegible]					.9
726								
727								
728								
729								729.3
730						Finished coring 6:20 PM		730.3 730.6 – 730.7 tuff ss (slightly distorted)
731			.03 .15					731.25
732								732.1 oil shale (low to med) with occasional thin ss seams
733								734.1
734								734.2 – 734.4 tuff ss with hydrocarbons [illegible] shale

THE CLEVELAND CLIFFS IRON CO.   PROJECT: [illegible]

HOLE NO: P-4 CORE SHEET 8 OF ___ DATE: 10/27-28/74 LOGGED BY: ________ COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10	20	30	40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
735										++++	735.55 (0.03' of tuff ss)
736			.3							..	} low to med grade, slighty coarser texture ~~& higher CaCO3 content~~
737									737.02		~~SHALE, well indurated, silty~~
738			[illegible]								~~buff - tan - [illegible] med brn,~~
739			.15						Started coring 11:05 PM 10/27/74		
740			.85							+++	slightly distorted bedding 740-740.8
741											discontinuous thin zones along break
742											
743	/		.00								SHALE AS ABOVE
744									18.74' REC., 18.74', 98.3% RQD		
745											
746			.10 .40								
747											
748			.30							++	
749			.70								
750											
751			~.90								
752											
753			40 .90								
754			.60								
755			~.20								
756											
757									756.5		silty shale, tan to lt. brn - ~~[illegible]~~
758											clayey parting at 757.2-
759			.20						STARTED DRILLING 5 AM 10/28		finely laminated with thin dk.
760			.60								colored bands
761			.10 .80								Siltstone, tan-lt brn. with thin
762											dk. colored bands
763											
764			~.30 .70								[illegible] undulating upper contact, blk [illegible]) color. parti.
765			.10								sandy siltstone, tan
766			40 .90						19.47' RUN, ZONE RELOG	+++	Siltstone, gray, banded.
767											
768											
769											
770			.90						RQD 97%		
771			.50 .70								
772											Siltstone, tan, finely laminated,
773											uniform
774			.63 [illegible]						FINISHED CORING 6:40 AM		Siltstone, tan to pale gray [illegible]
775			.20								?
776			.2[illegible]								
777			.40 .70						776.[illegible]	++++	Oil SHALE (same as above?) - finely lam. med grade to
778			.81 .07 .60						10/28 9:[illegible]		[illegible]) depth of 777.05
779		.40 .20 .50								....	Tuff SS (777.05 to 777.9) - [illegible] grains, petroliferous, distorted bedding, thin shale seams included
780		.4 .15 .5								....	
781		.15	.67 along cont.						STARTED CORING	....	Tuff SS (778.8 to 781.07) — coarse grained
782		*{.45 .80	55 .31							....	[illegible] tuff ss, petroliferous, highly distorted, mottled appearence (appears brecciated
783			.81								Siltstone tan to pale gray, finely laminated,
784											with buff clay seams (<0.01) slightly calcareous

COMMENTS: * These two fractures are very fine, & cemented shut, have offset siltstone lamina, dip in opposite directions across core, each at ≈ 30° to horiz

THE CLEVELAND CLIFFS IRON CO. PROJECT [illegible]

HOLE NO: P-4 Core SHEET 9 OF ___ DATE: 10/28/74 LOGGED BY: ________ COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
785								Siltstone (as above) 782.7 to 786.
786						19.85 Recov/19.97 cut RQD 17.85/19.85		has about 7° dip to core
787								782.7 to 790.1 all has dark
788								seams which carry hydrocarb
789			.55					
790								790.1 to 793.3 dark gray siltstone
791								bedding becoming thicker
792								
793						11:30 AM 10/28		793.3 to 794.58 light grey (thick
794			.58					Oil SHAle (siltstone) siltstone (beddin
795			.65					HAS A Browner color than oil shale further up hole
796						796.79		795.65-795.83 - tuff ss, magnetic, high in hydrocarbons, strong odor
797			.45			3:00 PM start coring 10/28/74		Silty SHALE 803.50
798								796.79 to ~~80~~ finely laminated
799								silty shale, light to dark brown,
800								dark seams often magnetite, low (
801			.05			19.94 Recov/20.00 cut RQD = 100		hydrocarbon content but has odor.
802								800.9 to 801.1 - highly petroliferous tuff ss, strong odor, black
803								Silty SHALE - finely laminated, grey (lt to dk)
804			.67					(803.5 to 804.2) med. calc.
805			.35				++++	Silty SHALE (804.2 - 806.85) buff to light brn., contains
806			.85					more v.f. grained sand, med. calc
807								& a 0.3' ss bed at 804.85 805.1
808								805.3 (0.1') of tuff ss (brn bleeding, odo
809								Silty SHALE (806.85 to end)
810								"Sandy Siltstone" GREY colored, fine to med.
811								lamina, (varying from buff, lt grey, dk
812						4:30 PM Finish coring		grey, blk.); Most of blk
813								lamina contain magnetite
814			.55					Grain size coarsening ~~[illegible]~~
815		•						throughout, on verge of
816			.69					Sandy Siltstone
817						816.79		SILTY SHALE - thinly laminated,
818			.28			7:20 PM Start coring 10/28		med. to dark grey (similiar to
819			.4 .85					above)
820			.32 .82					
821			.60					821.8 to 824.35
822						20.18 Recov/20.0 cut		Oil SHALE - Mahogany color, dark oil bearing
823							:	(silty shale) bands distorted, med grade
824			.35					Silty Shale
825			.75					824.35 to 827.1 (thinly laminated, med to
826								dark grey)
827							+++++	827.1 Oil SHALE - Mahogany colored med grade
828								(silty shale) interbedded, tuff ss are blk.
829			.60				+++++	829.5 & bleed hydrocarbons, & have strong odor
830			.65			Finish coring		830.25
831			.80					Silty shale - lt. color brn-buff, thinly
832			.53				++++	dark tuff ss (0.1') laminated, darker bands near
833			.45					base may carry hydrocarbons
834			.80 .10 .65					834.5 Mudstone (834.5 to 836.28)

Core in this section seemed extremely hard to break when hit by driller's hammer, shattered rather than break along PP

COMMENTS:

CLEVELAND CLIFFS IRON CO. PROJECT [illegible]

HOLE NO: P-4 CORE SHEET 10 OF ___ DATE: 10/29/74 LOGGED BY: ________ COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
835			.40 .83					Mudstone (CONT) - Buff colored, very
836			.17				+++	dark tuff (0.2') light color zone, med. laminations
837					836.1			SILTSTONE, buff - lt. gray - lt. brn
838								with a few thin dark bands
839			~ .80					
840								
841			60 .70				+++++	
842								SILTY SHALE, lt. - med brn.
843					17.83' RECOV, 20.00' cored			
844								
845			~ .15					← thin layer of shale between SS lenses
846			.80					
847								
848							+++++	
849			.30 .80				+++++	
850			.50					SILTSTONE, banded, finely
851			.15 .65 .90					laminated, buff - gray
852								
853								
854			.30 .90					gray SS
855			.70 .75					
856			.70					SILTSTONE, lt gray, gray with very
857			.90		855.9			thin darker colored bands
858			.50		STARTED CORING [illegible] AM			
859			.30					SILTSTONE - OIL SHALE with increasing amount of dark petroliferous material
860								
861								
862								OIL SHALE - Med to moderately
863								high grade
864			.20 .45 .55		20.00 CORED, 20.03 RECOV.			[illegible] clay parting
865								SILTSTONE, gray to buff with
866			.15 .20					very thin bands & indistinct zones
867			~ .70					of darker material - local occurrences
868								of soft sediment deformation
869								
870			.65 .50 .30				++++	
871								
872								
873			.70					SILTSTONE, brn - gray - buff
874								as above
875			.70					
876			.89				++++	
877					876.82			877.29 Oil Shale (Low to med. grade)
878			.48		11:35 AM start core 10/29/74			Siltstone (sandy), fine to med. lamina,
879								lt. grey to buff, some of fine lamina
880			.90					are claystone
881								
882								
883			> .50					
884			.17 .50					884.17 Siltstone dark grey & [illegible] buff laminae

COMMENTS:

THE CLEVELAND-CLIFFS IRON CO. PROJECT: White River Oil Shale ([illegible])

HOLE NO: P-4 Core SHEET 11 OF ___ DATE: 10/29/74 LOGGED BY: __________ COLLAR: _____ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
885						19.62 Recv/20.00 cut RQD = 17.87/19.62		Siltstone (as above)
886			.53					886.53 Oil SHALE, mahogany color,
887			.87					finely lamin., med. grade
888			.82 .35 .16					888.3 Siltstone – buff & brown lamina,
889			.13 .75					med. thick bedding, has few v. thin magnetit seams.
890			.89					-890.15
891		* Fracture	.26 .76					Siltstone lt. buff to lt. grey,
892			.82 .05 1.49					med lam. to 894.1 & coarse lam. below
893			.21 .52					Abundant magnetite in thin seams
894						Finish coring 11:35 PM		// to bedding (blk) & in very thin fractures
895			.27					cutting bedding (Vert. to sub. horiz.,
896			.61					& very irregular lines)
897								Siltstone (same as above), but
898						Start coring 5:20 PM 10/29		with less vert. magnetite stringers,
899								now mostly all parallel to bedding.
900								(899.0 to 899.9 distorted bedding)
901								901 Siltstone – buff to lt. brown,
902								less magnetite bands, med.
903						20. No Recov/19.96 cut RQD 19.74/20.16		laminations
904								
905								-905.75 Oil Shale – mahogany color, low to med.
906								grade
907								908
908								Siltstone (908.0 - 909.35), grayish brown, finely lam., mag. seam
909								-909.35 Siltstone (909.35-911.28)
910								lt. buff to brown, med. laminated,
911								911.28 No dark seams
912								Oil Shale low to med. grade, dk grey to
913								mahogany colored; richer below 914.45 & more finely laminated
914						8:15 PM stop coring		
915								915.66 914.81-914.99 – tuff ss, bleeding hydrocarbons
916								Siltstone (915.66 to 916.78) / buff to lt. brn,
917						916.78		med lam.
918								

COMMENTS: * This section of core shows many fine irregular fractures filled with magnetite healed to completely [illegible] (major dip of frac's appear to be 90° & 60°)(However pattern is basically quite irregular)
Surface (1:1). Top section

HOLE NO: X-1 SHEET 1 OF __ DATE: 24 NOV '74 LOGGED BY: E.C Gentzler COLLAR: ____ TD:

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
35	50				Siltstone, lt Gry, sltly Calc.
50	60				Sandstone, lt Gry, f. to med. grnd, w/ much feldspar
60	70				& some Biotite. Ang. to subangular grains, mod.
					sorted, & Calc cement
~~70~~	~~75~~				
70	75(?)				Shale, med Brn, thinly-bedded, ~~Fl~~ fissile.
75(?)	80				Sandstone, lt Gry, f. to med grnd
80	90				Shale, lt. Gry to med Brn, thin-bedded, fissile
90	100				
100	110				Siltstone becoming Sandstone, lt gry, v f. grnd
110	120				Sandstone, (as above)
120	130				
130	140				
140	150				(~~Becoming~~ Some lt Brn)
150	160				
160	170				
170	180				Becoming Coarse-grnd
180	190				
190	200				fine-grnd
200	210				
210	220				
220	230				SHALE, lt to med Brn, fissile, soft
230	240				SHALE, LT TO MED BR (CALCARIOUS). MOULTON 1200 hr
240	250				CALCARIOUS SHALE - LT BR WITH SOME SAND
250 ~~250~~	~~260~~ 260				FOSSILS " " " " " "
260 ~~260~~	~~280~~ 270				SANDSTONES RED BR TO LT BR - CALC. SHALES AT BOTTOM
270 ~~270~~	~~280~~ 280				GREEN CALC. SHALES &
280 ~~290~~	~~300~~ 290				GREEN CALC SHALES BECOMING SANDS
290 ~~290~~	300				SHALE LT GR TO LT BR (CALC)
300	310				SANDSTONE LT GR TO BR BITHUMEN FLAKES
310	320				SANDSTONE LT GRAY TO BROWN
320	330				SANDSTONE LT GRAY TO BROWN
330	340				" " " " WITH BITHUMEN LENS
340	350				SANDSTONE " " " (SMALL SAMPLE)
350	360				SS. LT GRAY TO BR.
360	370				" " " "
370	380				SS LT GRAY (SMALL SAMPLE)
380	~~400~~ 390				SS " " WITH BITHUMEN CHIPS OR LENS
390	400				SS " " (SMALL SAMPLE)
400	410				SS " " (SMALL SAMPLE)
410	420				SS " " SOME BLCK FLAKES (SMALL SAMPLE)
420	430				SS " " " "
430	440				SS " "
440	450				SS " " WITH VISIBLE DARK BRN GRAINS

HOLE N: X-1 SHEET 2 OF ___ DATE: 11/24/79 LOGGED BY: W. MOULTON COLLAR: ______ TD: ______

FROM	TO	±MM	ASSAY 10	20	30	40	GAL/TON	DESCRIPTION
450	460							NO SAMPLE
460	470							SS LT. GRAY GRADING INTO A BR. SHALE
470	480							BR SHALE HARD AND FISSILE
480	490							BR SHALE " "
490	500							SHALE, med. to dk Brn, fissile ~~[illegible]~~ @ first but becoming
500	510							less so w/ depth, & variable organic content.
510	520							
520	530							
530	540							
540	550							
550	560							
560	570							
570	580							
580	590							
590	600							w/ minor amts. of Ss, lt. Gry, fn-grnd (Probably thin lens)
600	601							
601	602							Probable Nahcolite Zone
602	608							SHALE, med. to dk Brn, somewhat fissile w/ occ. chips lt Brn, MARLSTONE
610	620							SHALE MED TO DR BRN. (CALC)
620	630							" " " "
630	640							SHALE LIGHT BR (HARD)
640	650							SHALE LIGHT BR GRADING INTO DR. BR.
650	660							SHALE DR. BR.
660	670							" "
670	680							" " CALCARIOUS
680	690							SHALE DRK BR WITH LT BR LENS (FISSLE)
690	700							" " 697-698 KELLY BAR DROPPED
700	710							" " APPROX 1-2' VOID & OR
710	720							" " FRACTURE ZONE
720	730							SHALE, Med-dk Brn, fissile
730	740							
740	750							
750	760							
~~[illegible]~~	~~[illegible]~~ 770							SHALE, Dk to V. Dk Brn, fissile
770	780							
780	790							
790	800							
800	810							
810	820							
820	830							
830	840							
840	850							
850	860							
860	870							

CLEVELAND CLIFFS IRON CO. PROJECT: [illegible] SHALE

HOLE NO: X-1 (CORE) SHEET 1 OF 6 DATE: 27 Nov. '74 LOGGED BY: E.C. GENTZLER COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
CUTTINGS (LOGGED) ABOVE THIS DEPTH ON ANOTHER FORM								
870			.45			870.00'		SILTSTONE: - Med. Brn, finely laminated
871	150							w/ occ. bits of bitumen, some v. thin
872	+100							layers of py & [illegible], & some thin,
873		45°	.14					tuff ss. layers - generally w/ distinct
874		10°	.45 .55					upper & lower contacts, [illegible]
875		75°	.46					[illegible] concretion
876						% RQD		tuff SS layer (877.08-.15), distinct low.
877	150?	30°	45 .40 .41					contact, Saturated w/ dead oil.
878		.55	.44 .51					(cutts on Vert frx 1.51 [illegible])
879		[illegible]	.72					
880		V Dirt 91	.57 .46			% RECOVERY		
881	120							
882	+[illegible]		.53					
883								<2 [illegible]/ Sut.
884								
885			.56					Tuff Ss. (885.56-.74), sil. gm, oil Saturated
886						ECG		distinct low. contact, upper contact is a
887								Hematite layer (.6 cm)
888			.67					
889								
890						30.18' CUT / 30.11' REC. 4:30 AM - 27 Nov. 74		Tuff Ss. (890.48-.53), oil soaked
891								
892	+110							
893								
894								
895			.55					
896								
897			.61					
898								Tuff Ss (898.75-.81), irreg contacts, some oil
899								[illegible]

HOLE NO: X-1 SHEET 2 OF 6 DATE: 12/2/79 LOGGED BY: W. MOULTON / E.C. GENTZLER COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
900			.80			900.11		OIL SHALE MED-DRK BRN
901			.34			CUT 30.00'/REC 30.33' 12/2/79 9:00 AM	+++ 900.35	FINELY LAMINATED WITH SOME
902	+100						901.34 +++	SANDY LENS
903		VERT.						
904							+++	904.05-904.20 SANDY ~~BEDS~~ LAYERS
905								
906								
907		907.30						
908							+++	908.53-908.95 SANDY ~~BEDS~~ LAYERS
909								
910								
911								
912	+90							
913								
914								
915								OIL SATURATED WM
916			.01				+++	916.14-916.34 SANDY ~~BEDS~~ LAYERS
917							+++	917.50-917.86 " "
918								
919								
920			.55				+++	920.95-921.05 SAND ~~BEDS~~ LAYERS
921								
922	+50		.85					
923								923.70-923.X SANDY ~~BEDS~~ LAYERS
924								
925								925.56-925.71 SANDY ~~BEDS~~ LAYER
926								
927								
928								
929		VERT	.50					
930		.55				930.44		
931			.76			CUT 30.00'/REC 29.58'		931.96-932.19 LOST .23 FEET OF CORE
932	+70		.19					
933								OIL SHALE MED TO DK BRN ~~WITH~~
934			43					FINELY LAMINATED WITH INNER
935			.44					BEDDED SAND LENS.
936								935.44-937.06 LOOK
937			.06					WAVEY BED
938								CONTORTED SAND LAYER
939			40					
940			.71					
941								941-944 DARK BRN BANDS OF
942	+60							RICHER? OIL SHALE
943								
944								
945								946-949 DARK BRN. BANDS OF
946			.50					OILSHALE (SOME BLACK)
947								
948			.38					
949								

HOLE NO: X-1 SHEET 3 OF 6 DATE: 3 DEC 74 / 4 DEC '74 LOGGED BY: W. MAXTON / E.C. GENTZLER COLLAR: ____ TD: ____

LISTED LOST CORE INTO FAR ZONES.

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
950		.79	.32 .74					OIL SHALE DARK BRN to BLACK
951		.74						FINLEY LAMINATED WITH SOME
952	+50							INNER BEDDED SAND LENS
953			.58					
954			.67					
955			.88					
956								LOST CORE 957.11 TO 957.30 (.19' LOST)
957								- Not Lost ON BOTTOM & RECOVERED ON
958			.71					NEXT RUN. - ECG
959		.00	.73					
960		.44				44 10.0		~~[illegible]~~
961						(1.22' FROM ABV.) = 10/10 ECG		SHALE - SILTSTONE, V. Hard & silty to med carb sh, med-dk Brn, f. lam.
962	+40							w/ f. thin py-lam. layers, occ. v. thin pods of
963								Bitumen, & thin tuff-ss beds (freq w/ dead oil.
964								
965								Low Grade (oil) zone (965.10-.75) w/ a thin
966								Tuff SS (965.24-.27), highly contorted lower con
967								tact & Oil Saturated.
968			.61 .78					Low Grade Zone (968.55-969.35)
969							+ +	SHALE (as ABOVE) but lt-Med Brn.
970								Contains thin lam. of Lt Buff Dolomite
971								
972	+30		.38					
973		.47	.47 (irreg)					NAHCOLITE (?) - thin layer (.03) chalky, white along
974								irreg. p.p. (973.47) & as blebs & disseminated
975		.75	.97			CUT 30.38 / 29.78 RECV. 3:25 AM - 4 DEC '74		layers below this. OIL SHALE. low grade (976.08 -)
976		.97					H	~~becoming~~ Med Brn to Gray w/ much Marcasite
977		.55 .94	.10 .94				H	along f. lam. in upper parts i.e. f. grd, f. lam.
978			.21 .51				H	
979							H	
980			.62					
981								
982	+20							
983			.32					Tuff Ss lens (983.76-.84) Oil sat, irreg contacts
984							-H-	
985								Nahcolite (?) Zone (985.37-.56), white-Buff, chalky,
986								distorted, w/ much py's lam., some calc.
987								} Zone w/ many v. thin lam. of Nahcolite, also thin are
988			.68					v. thin, irreg., oil sat, Tuff SS beds in distorted zone.
989						7.0		Tuff SS (988.75-989.15), irreg, oil sat. Add'l thin
990			.28					" " below w/ thin layers of Nahcolite & typ's bitumens
991								OIL SHALE HARD WITH FINE BEDDING
992			.25 .14					LIGHT BRN TO BLACK WITH INNER BEDDED
993			.81					ZONES OF OIL SATURATED ~~SATURATED~~
994								SANDS AND ~~SOME NAHCOLITE [illegible]~~
995								AND BEDS.
996								
997								994-1000 LIGHT BRN LOW GRADE
998								OIL SHALE WITH SOME INNER BEDDED
999								ZONES OF NAH ~~[illegible]~~ SS (TUFF)

HOLE NO: X-1 SHEET 4 OF 6 DATE: 4 DEC '74 LOGGED BY: W MOULTON COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10	20	30	40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1000			.74								SANDY LAYERS THROUGHT SECTION
1001											ARE OOZING OIL
1002	O	1003.07 ↑ VERT FRX ZONE	.39						LOST CORE ZONES BOTTOM OF SECTION	+++	10[illegible] - 1002.77 SANDY LENS (W/OOZE)(OIL
1003											MAHOGANY MARKER (→
1004											RICH OIL ZONES BELOW
1005		1005.62									.68
1006			.69 IRR							+++	FRACTURE IN A SMALL SAND LENS
1007			.00 .09 .15								IRREG. BREAK
1008											1007-1012 DARK BLACK OIL ZONES
1009											
1010									CUT 21.75 / REC 22.90 WWM 11:50 AM + 4 DEC 74		1011.[illegible] - 1012.55 thin, irreg layers of tuff s.s.
1011										+++ ***	[illegible]
1012										+++ ***	thin irreg layers of tuff ss SAND [illegible]
1013			.86								1011.5 - 1013.0 many very small inclusions intermittent very thin zones of tuff ss with some slight bedding distortion around inclusions
1014			.12)(.33)(.3)								1014-1016 HIGH GRADE OIL SHALE
1015		1015.?3 1.?/60°	57.66							***	LENS WITH HIGH GRADE OIL SH.
1016											NAHCOLITE
1017			.89								
1018										+++	1018.67-.70 SAND LENS
1019									1020.00		
1020											LOST .85' OF CORE)
1021		1021.45 to 1022.[illegible]	→ .01' OFFSET								OIL SHALE MOSTLY HIGH GRADE
1022	.20	/60°	.10								DARK BRN TO BLACK - IRREGULAR
1023		(?.50°)									THIN BEDDING WITH SOME
1024		.11-.42									CONTORTED SAND LENS
1025		/60°	.33								NAH ~~[illegible]~~
1026										+++	.2 - .78
1027			.23								VERY BLACK OIL SHALE
1028			.41								↓
1029									W.W.M.		
1030											
1031											
1032	±30								CUT 30.00' REC 30.34' 6:00 PM 4 DEC 74		32.28-33.13
1033			.11							+++	.13 - SAND LENS
1034											
1035										+++	BANDING SEEN BETWEEN ZONES
1036											OF BLACK BROWN AND LIGHT BRN
1037											OIL SHALE
1038											
1039											LIGHT BRN SH WITH DRK BRN BANDS
1040											SOME NAHCOLITE
1041											
1042	±40									**	
1043			.44								LIGHT BRN OIL SHALE
1044			.97								
1045			.38								
1046											
1047			.7								.09 .41 CALCITE LENS ?
1048										***	
1049											

COMMENTS: FR EXIST MOSTLY TO CONTACTS BETWEEN SAND LENS AND OIL SHALE

HOLE NO: X-1 SHEET 5 OF 6 DATE: 5 Dec '74 LOGGED BY: E.C. Gentzler COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1050						.31		Oil Shale, low Grade, lt-Med Brn, Hard, V. Calc
1051								
1052	-50							Mod Grade Zone (1052.0 -1053.0)
1053								
1054			.12 .54 .45					
1055			.67					
1056								
1057			.50					
1058								~~Ex~~ only Slightly Calc. (1059.2-1062.3)
1059			.40 .60 .87					Tuff. Ss (1059.95-1060.30) w/ ~~[illegible]~~ 1?, Oil Sat.
1060			.62 .68			= 100+ %		
1061			.83 (irreg)					Mod Grade Zone - w/ Some layers (.01' thk) of high Gra
1062	-60							tuff. Ss layer @ top bleeding oil.
1063								
1064						'74		
1065								
1066			.10					Mod-high Grade Zone w/ numerous thin lam. of ~~Nahco~~ tuff
1067								
1068			.34					
1069								Nahcolite layer (1070.22-.25), chalky, white, lam.
1070			.22					
1071			.85					
1072	-70						Mod-High Grade	Nahcolite (??) (1073.20-.22) dk Gray ! frings mult...
1073			.73 (irreg)			29.79' CUT / 29.84' RECOV.		Nahcolite (1073.48-.64) distorted, buff
1074			.12 (irreg)			ECG + 5:30 AM - 5 DEC		Tuff. Ss (1073.64-1074.22), Calc. altered, Gilson Ace
1075			.50 .52 ?	/				~~Nahcolite of Gilsonite~~ (1075.10-.15) Tuff layer
1076								
1077								becoming silty
1078			.39					
1079						1080.10		
1080								OIL SHALE. LOW TO MOD GRADE, HARD
1081								WITH INNER BEDDED SAND ~~[illegible]~~ LAYERS AND
1082	-80							BITUMEN ZONES - BITUMEN ZONES
1083								ARE OOZING.
1084								ALL THE ABOVE ARE THINLY BEDDED
1085			.36					
1086		1086.73-1088.65				REC 31.75		
1087		VERT				5 DEC '74		
1088								
1089			.71					
1090		.22 VERT ZONE	.22 .50 93					.25-.5 SANDY ZONE WITH SULFIDE LAYER (MARCITITE ?) ALSO BITUMEN
1091		1091.31	.31			32.83' cut		
1092	-90					1:30 PM		OOZE ZONES (LENS OR BLEBS) BITUMEN
1093								
1094								
1095			.33 (76)					1095.82-1096 SANDY LENS WITH SULFIDE ZONE GEN MARCITITE,
1096								OOZE ZONES (BITUMEN)
1097								" "
1098								" "
1099	1099	.45 VERT	.45					" " VERT FRACTURE OPEN GAP

HOLE NO: X-1 SHEET 1 OF 6 DATE: 5 DEC. '74 LOGGED BY: [illegible] MOULTON COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1100		.71						OIL SHALE LIGHT BR TO GRAY LOWGRADE
1101			.44					WITH SANDLENS ~~+ MARCASITE~~
1102	100					21.75 REC 5 DEC '74		1102.35 - 1103 SANDY ZONE WITH ~~[illegible]~~
1103								1.4+12 SEAMS
1104								SOME BITUMEN LENS AND TUFF
1105			.49					~~MARCASITE~~ ZONES
1106						21.85 CUT 1:02 PM		
1107								
1108								
1109								
1110						1109.55		
1111								OIL SHALE - LOW TO MOD GRADE
1112	110							LIGHT BR TO DRK BRN V. HARD
1113								THINNLY BEDDED WITH INNER
1114			.40 .33					BEDDED ~~MARCASITE~~ AND SULFIDE:
1115			.17					MARCITITE, PYRITE -
1116			(.16)(.7[illegible])				xxxx	ALSO SOME SAND LENS
1117			(.07)(.22)(.41)(.52)(.73)(.67)					
1118			(.44)(.56)					
1119							xxxx	} ~~MARCASITE~~ (THIN) .01'
1120							xxxx	
1121							xxxx	
1122	120		.35					
1123			.15					
1124			.11					
1125			.26				xxxx	} ~~MARCASITE~~ THIN .01'
1126								
1127			(.46)(.67)			100%	xxxx	.46-.67 SANDY LENS W/MARCITITE
1128			.05 .19					.05 - .19 " "
1129			.30(.60)					.30-1130.13 " " W/MARCITITE
1130						20.15 REC 6 DEC '74	xxxx	
1131			(.53)(.90)					
1132	130	1.98	.05				xxxx	~~MARCITITE~~
1133		1.34	.33 .79					BLACK SAND ? .50 - .69
1134			.76					
1135			.12			20.15 CUT 10:00 PM		
1136								
1137							xxx	
1138			.34					
1139			.15(.53)				xxx	
1140	138					[illegible].05 END		MOD GRADE OIL SHALE

HOLE NO: X-2 SHEET 1 OF 1 DATE: 11/24/74 LOGGED BY: G.D. AHC / C.J. Hansen COLLAR: ______ TD: ______

FROM M	TO	±MM	GAL/TON	DESCRIPTION
0	7			OVERBURDEN
7	22			
22	30			Siltstone, Brn, mod. calc.
30	40			siltstone, Brn, slightlly calc.
40	50			siltstone, lt. Brn., slightly calc., pyrite, carbon flecks
50	60			siltstone, Brn., pyrite, slighty calc.
60	70			siltstone, Brn., slightyly calc., pyrite
70	80			Siltstone, lt. brn to grey, arg., slighty calc., few carbon flecks.
80	90			siltstone, brn to dk grey, mod [illegible] lam., sl. calc., mica on P.P.
90	100			siltstone, brn, mod calc., with buff f.gr. SS
100	110			SS, f.gr., grey, non calc (Some med gr.)
110	120			Siltstone, brn to dk brn, mod. calc., v. minor mica flecks
120	130			Siltstone, brn to dk brn, mod calc, Mica on P.P. & buff, f. SS, mod calc
130	140			siltstone, dk brn, mod calc, mica flecks (w occassional f.g. lt SS)
140	150			Siltstone, brn to dk brn, sly. calc., mica flecks
150	160			SS, f.g., buff, mod calc, pyrite w siltstone, dk brn, sly. calc.
160	170			siltstone, f. lam, lt to dk brn, sly. calc., mica flecks
170	180			siltstone, dk brn, med calc,
180	190			siltstone, dk brn. & SS, lt. gry, w Hcarbon flecks & pyrite
190	200			SS, lt to med grey, pyrite, Hcarbon flecks
200	210			SS, lt grey, f.g. & siltstone, dk brn.
210	220			Siltstone, dk brn, w. calcite & nahcolite ped & SS, buff, calc
220	230			siltstone, dk brn, nahcolite blebs, med calc.
230	240			siltstone, brn to dk brn, nahcolite, sl. to mod. calc., minor buff SS
240	250			Siltstone, dk brn, abund. nahcolite & calcite (highly eff.)
250	260			(Same as above)
260	270			siltstone, brn to grey, non calc, w calcite & pyrite x-tals on surfaces
270	280			siltstone, dk brn, calcite oolitic texture, nahcolite; cal & effervesces but not re
280	290			Siltstone, dk brn, med to st. calc. (Marlstone?) nahcolite grds
290	300			Siltstone (Marlstone) brn, med to st. calc, w some dk br v.f.g. SS
300	310			Sandy Siltstone (Qtz & pyrite grains), lt brn, mod calc, w some dk brn siltstone
310	320			Siltstone, dk brn, w calcite & nahcolite blebs, mod calc, w buff f.g. SS
320	330			Siltstone, dk brn, thin lam, med to st. calc (Marlstone), w minor calcite & Hcar
330	340			siltstone (Marlstone), dk brn, med. to st. calc, w calcite & minor Hcarbon & SS siltstone, buff, f.g.
340	350			siltstone (Marlstone) brn, med to st. calc., w. minor calcite & Hcarbon
350	360			siltstone (Marlstone) lt. to dk brn, mod. to st. calc., minor pyrite
360	370			(Same as above)
370	380			siltstone (Marlstone), brn, med to st. calc.
380	390			siltstone (Marlstone), dk brn, med. calc., w calcite & pyrite X-tals
390	400			siltstone (Marlstone) dk gray to brn, thin lam, med to st. calc.
400	410			siltstone (Marlstone) dk gray to brn, med to st. calc, minor pyrite, H-carbon, & magneti
410	420	—		Siltstone (Marlstone) gray to brn, mod. calc., w gilsonite, Hcarbon, & pyrite blebs
420	430			Siltstone (Marlstone) dk brn, med to st calc
430	440			Siltstone (Marlstone) dk brn, med to st. calc
440	450			Siltstone (Marlstone) dk brn, med calc, w pyrite
450	460			Siltstone, dk brn, sly. to med. calc., mica on P.P., minor gilsonite & Hcarbon
				11/26/74
	460			START CORING

IRON CO. PROJECT:

HOLE NO: X-2 SHEET 1 OF __ DATE: 11/27/74 LOGGED BY: G.J. HANSON / G.D. AHO COLLAR: 5810(±) TD: 765.8

DRILLING CONTRACTOR:
LAYNE WESTERN

RIG: GD 2000
DRILLERS: COX (NOON-MIDNITE), KAUZLARICH (MIDNITE-NOON)
METHOD: AIR MIST; 6 3/4" Christensen bit

SERVICE CO: WESTERN AIR.

GEOLOGIC SYMBOLS:

+ + + +	tuff ss
✱ ✱ ✱	NAHCOLITE
- - -	BITUMEN FLECKS
☐	HIGH GRADE OIL SHALE
H H	HEMATITE, PYRITE, OR MARCASITE layers, blebs, or isolated X-tals

DEPTH	±MM	FRX		REC. RQD			DESCRIPTION
				460.0			
460						.25	OIL SHALE (siltstone/MARLSTONE)
461				12:00 NOON			V.f. lam., dk gray to brn with
462				START CORE 11/27/74			occasional buff lamina, generally
463							mod. eff. (higher grade zones are
464			4.20		+ + + + ✱ ✱ ✱	4.65	MAHOGANY color) Few thin tuff S.S.
465		—	5.90	19.61 REC/19.78 CUT	- - -	5.47	lamina as noted.
466	—	—			+ + +		
467	—	—					464.20 - tuff ss, gray to dk gray, 0.02'
468	—	—		RQD = 100			464.95 - tuff ss, dk brn, w Hcarbons, 0.05'
469	—	—	9.50				466.30 - same ss as above, 0.05'
470	—						
471	—	—	1.58		+ + +		471.58 - tuff ss, dk gray, 0.07'
472	—	—					
473	—	—		stop core			
474	—	—	4.40		+ + +		474.40 - tuff ss, dk grey, v. thin, irregular
475	—	—					
476	—	—		2:30 PM			
477	—	—	7.97		+ + + +		477.97 - tuff ss, dk gray, 0.05
478	—	—	8.04			8.95	
479				479.18			
480	—	—			+ + + + +		OIL SHALE v.f. lam., dk to brn, generally
481		—		4:45 PM	+ + + +		mod. eff., w. V thin tuff ss lam,
482		—		START CORE 11/27/74	-		(thicker ones noted)
483		—			-		479.88 - (0.07') tuff ss, brn w Hcarbons
484	—	—			- -		479.97 - (0.05') tuff ss, brn w Hcarbons
485	—	—	1.5		+ + + +		481.5 - (0.05) tuff ss, gray
486	—	—				6.8	481.92 - (0.02') tuff ss, gray
487	—	—		22 CUT	+ + + +	488.0	485.09 - (0.0?') tuff ss, dk gray
488	—	—			+ + + +		485.97 - (0.02') tuff ss, gray

THE CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: X-2 SHEET 2 OF ___ DATE: 11/27/74 LOGGED BY: G.D. Arto / C.J. Hanson COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
490			0.4				+ + +	Oil SHALE (as above)
491						RQD=100		
492								490.4 - (0.03') tuff ss, gray
493							493.55	491.34 - 491.74 buff color, siltstone,
494							494.6	v.f. lam, med eff.
495								Oil Shale - below 491.74 (buff zone) the
496						7:30 PM stop core 11/27/74		color becomes darker brn to end
497								of run, f lam, med. calc. oil shale.
498								
499								
500						500.0	+ + + +	OIL SHALE - predominately dk brn w
501							500.92	some dk gray lam, v.f. lam,
502							+ + + + 501.95	med. to st. efferv., low to med grade except where noted.
503			3.62			12:45 PM start coring 11/29	+ + + +	
504								500.83 - tuff ss (0.1'), lt. brn w [illegible]
505								502.18 - tuff ss to 502.28 (≈0.1'), dk
506								brn, distorted contacts, w [illegible]
507						Core ground up ∴ rec. poor & RQD undeterminable		503.6 - dk brn, dk brn tuff ss (0.05')
508							+ + +	508.23 - tuff ss (0.05') } dk brn, w. [illegible]
509							+ + +	509.00 - tuff ss (0.05') } [illegible] thick,
510			0.61					510.15 - tuff ss (0.20') } odor
511	+130							510.61-519.90 - left in bottom of hole
512								& Recovered partially with next 6'.
513								However - much of core was ground
514						3:15 PM Finish coring		up & pieces recovered were badly
515								broken. Most of it is dk brn
516								Oil Shale (silty shale) med. to st. efferv.
517								≈ 4' of sample rec. out of 9.3' cut,
518								but largely due to faulty core catcher
519						520.0		
520						6:20 → 11/29		Oil SHALE - brn to dk brn w. few thin
521	+180						1.3 2.0	buff lamina, v.f. lam, med. to
522								st. calc., low grade.
523						7:30 PM 5.98 rec/5.98 cut RQD=100		
524							+ + + +	524.45 } tuff ss (0.08') - dk brn tuff ss
525						525.98	+ + +	.75 & 525.3 (0.1') carrying hydrocarbons, wavy contacts
526							+ + +	OIL SHALE - brn to dk brn w. tuff ss
527			7.77				+ + +	as noted. Med calc., vf lam.
528						12:30 PM start coring 11/30/74	+ + +	Higher grade zones of oil
529			9.09					shale. Mahogany colored, few
530			0.65 0.57 0.88				+ + + +	thin buff color. laminae.
531	+110							Tuff ss:
532								526.5-6.86 dk. brn, wavy contacts,
533			3.97					527.11-7.70 dk. brn, wavy conts, odor
534								528.75-8.80 dk brn, wavy cont's
535						20.1 rec/20.03 cut RQD= 19.2/20.1	+ + +	530.7-0.95 dk brn, wavy cont's, odor
536							+ + +	535.77-6.33 (same as above)
537							+ + +	536.47-6.53 (" " ")
538			8.47					537.00-7.09 (" " ")
539		650	9.31					

COMMENTS: CREW FINISHED SHIFT AT 7:30 PM 11/27/74 & STARTED AT 12:45 PM 11/29 [illegible] ONE SHIFT; BECAUSE OF THANKSGIVING SOME OF CREW LEFT. 11/28 DID MAINTENANCE WORK ALL DAY.

Hole fill from 500-520 came out with only 10.61' core - changed core catcher. Went back in over core but ground part & drilled another 6' to 525.98.

HOLE NO: X-2 SHEET 3 OF ___ DATE: 11/30/74 LOGGED BY: G.D. Aho C.J. Hanson COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
540							+ + +	Oil SHALE brn to dk brn, med calc, v.f. lam, w
541	+100							few buff lamina.
542			2.07			3:25 AM STOP CORE	+ + +	Tuff ss { 540.18-0.23 } dk brn, wavy
543								542.56-2.63 contacts, w
544		45°	4.15 4.20				+ + +	544.17-4.20 Hycarbons, semi
545						546.01	+ + +	545.69-546.10 gilsonite, odor
546						10:45 A.M. start core 12/1/74		Oil SHALE — brn to dk brn, f. lam,
547								med. to St. calc, low grade
548								
549			9.68				+ + +	Tuff ss { 549.53-9.60 } dk brn, wavy
550								549.78-9.88 contacts, w
551	+90					20.18 Rec / 19.97 cut, RQD = 100	═	1.87 554.58-4.65 Hycarbons, gilsonite
552								2.43 Flecks, odor
553								
554			4.62				+ + +	Silty Shale - buff colored, St. calc, low grade
555								(555.85 to 556.85)
556			6.0					Oil Shale - brn to dk brn, f. lam, med to St.
557								calc, low to med. grade
558			8.07					tuff ss
559								561.43-1.48 (brn, zone w)
560								Hcarbons
561	+80		1.43 1.48			STOP CORING 1:40 PM	+ + +	tuff ss { 564.11-4.16 - dk brn, Hycarbons
562								odor
563								3.96 565.04
564								4.90
565			5.65				+ + +	Tuff SS (565.01-566.71) - tan to brn
566			6.61			565.48	+ + +	6.11 to dk, low Hycarbons, mica & magnetite
567			7.84			start core 3:45 PM 12/3/74		grains, highly distorted bedding & contacts
568								non-calc. UPPER WAVY BED
569							+ + +	Oil Shale (6.71→)
570								brn to dk, f. lam., med calc, low to
571	+70							med grade oil shale, few v. thin
572			2.90			19.97 Rec / 20.01 cut RQD = 100		high grade seams - larger ones noted.
573								3.20 3.53
574								Tuff ss.'s
575							+ - +	569.08 (.02') } dk brn, v. little
576								575.62 (.02') } Hycarbons
577								
578			8.10					
579							- - -	
580								
581	+60					stop core 7.00 PM	- - -	
582								
583								
584								
585								Oil Shale - brn to dk. brn, f. lam., med.
586						585.99		6.91-6.96 effer., med. grade oil shale. W.
587						start core 11:30 PM 12/		few higher grade zones
588								
589								

on 12/3/74 & labeled as such on log.

HOLE NO: X-2 SHEET 4 OF ___ DATE: 12/4/74 LOGGED BY: G.T. And [illegible] COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
590								Oil Shale (as above, continued)
591	+50							1.60
592								W. few buff colored seams of
593						20.01 rec/19.98 cut RQD = 100		3.20 siltyshale as listed: (594.55-4.60)
594								(602.18-2.24)
595								(605.38-5.45)
596								
597								
598								
599								9.32 Tuff ss. (599.69-599.75)
600								0.59
601	+40					Stop Core 2:05 AM 12/4/74		
602								
603								3.43
604								4.46
605								
606						605.97		Oil SHALE - low grade silty shale, brn
607			7.15 7.39			Start Core 5:30 AM 12/4/74		to buff, w. calcite filled cavities
608								(607.25 to 611.88) - calcite
609			9.20					cavities from (611.55-611.70)
610								Oil Shale
611	+30		1.30					1.88 gray to dk. gray, med. grade oil
612			2.46			19.95 rec/20.02 cut 18.17/19.35 RQD =		shale from 611.88 to 617.85 w.
613			3.18					higher grade zone from
614			4.55 4.80					617.85 to 621.23
615								
616			6.00					Lenses & Blebs of tuff ss
617			7.42					7.85 from 621.40 - 623.50
618								
619			9.37					Oil Shale shows irregular, wavy, lamina
620			0.26					from 620.09-625.00
621	+20							1.23
622						Stop core 8:05 AM		Oil Shale - dk brn to gray low to
623			3.04					med grade oil Shale ~~[illegible]~~, med
624								Calc.
625			5.10					5.31 Tuff ss, bleeding Hcarbons (624.74-4.78) (625.05-5.09)
626			6.05			625.97		Oil Shale (625.31-627.80) (625.23-5.31)
627						11:00 AM Start core 12/4/74		7.80 brn to dk brn w. some tuff lamina,
628								med to st. effer; med. to high grade oil
629								shale, thinly lam, & distorted bedding
630								0.16. Mahogany Marker (?)
631	+10		1.34					1.68 626.04-6.40 } tuff SS, dk brn to
632								626.44-6.48 dk gray, distinct
633						19.99 Rec/19.98 cut RQD = 100		626.80-6.89 contacts, contain magnetite, minor Hcarbons
634								[illegible] 631.16-1.21
635	-		5.29					631.98-632.13
636								Oil Shale (631.68-637) low to med grade,
637								tan to lt brn., med to st. effer,
638			8.19					
639			9.80					

THE CLEVELAND-CLIFFS IRON CO. PROJECT [illegible]

HOLE NO: X-2 SHEET 5 OF ___ DATE: 12/4/74 LOGGED BY: G.D. Ahc / C. Johanson COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
640			0.42					Oil SHALE (637→) brn to gray, thinly
641	0		1.67			1:45 PM stop coring		lam., low to med grade, mod. effer.
642								
643								Tuff SS
644								641.13-641.18 } f grained, dk brn
645			5.67					641.45 - 1.50 } to blk, magnetite,
646						645.97 START CORE 4:15 PM 12/4/74		6.0 641.71 - 1.73 } minor Hycarbons'
647								Oil Shale - buff to lt. brn to reddish,
648								7.83 dk brn, f. lam., mod calc., med
649								grade, with higher grade zone
650			0.13 0.43					0.9 being mahogany to black in color
651	-10							
652						16.00 rec/19.98 cut RQD 12.05/16.00		Thin (0.02') tuff ss, lt gray at 653.0
653								
654			4.03 | 4.60 | .88					
655			See note (2)					5.0
656								
657								Core BADLY BROKEN - MANY v. thin poker chip
658								pieces, apparently zone of lost core, all
659								pieces are high grade oil shale
660								0.70
661	-20		1.20 1.50			STOP CORING 7:20 PM		1.67 } ZONE of solid crystals of Nahcolite
662			2.10 2.20					& calcite, highly efferv., only partially
663			3.0 3.45					3.48 } dissolved, some of crystalline material 3.97 is translucent brn w/ a vitreous to
664			4.30					4.30 waxy luster - A very distinctive zone
665								5.74 Tuff SS - 665.74-665.95 (brn w/ wavy bedding
666						665.95 START CORE 10:50 PM 12/4/74		6.0 Oil Shale
667								dk brn to mahogany to blk,
668			8.30					8.13 high grade oil shale, f. lam.,
669			9.70					mod. calc. - Higher grade
670						20.05 rec/19.0 cut * RQD = 14.95/21.05 *		0.40 zones only slightly efferv.
671	·30		1.56					
672			2.76					2.62
673			3.74 | .38 3.45 | .83					
674			4.15 | .41 .70					4.21
675			5.21 5.63					5.58
676			6.38 6.91					6.31
677			7.31 | .91 7.62					
678			8.22 .55					
679			9.50 .93					
680			0.44 .75			STOP CORE 1:15 AM 12/5/74		Oil Shale - dk brn, f. lam, mod. calc.,
681	-40		1.33 .68					low to med grade (680.0-684.55
682			2.11 | .97 .41					
683								684.55 to 685.47 wavy bedding
684			4.13 .85					4.55 in oil shale
685			5.47			685.47 6:15 START CORE 12/5/74	5.47	Oil Shale buff to dk brn, f. lam.,
686								mod efferv., low to med grade
687								except where higher grade noted.
688			8.25					
689								9.2

COMMENTS: * Extra core apparently left on bottom from last run, HAD TO ADJUST FOOTAGE MARKED ON CORE (RQD = 14.95 - .05)

CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: X-2 SHEET 6 OF ___ DATE: 12/5/74 LOGGED BY: G.D. Atto / C.J. Hanson COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
690								0.45
691								
692						20.11 Rec/19.97 cut RQD = 100	+ + +	2.38 2.58-2.70 – lt. brn tuff SS w.
693								3.77 Nahcolite & calcite
694			4.33					
695								
696								
697								
698			8.68					
699								9.14 9.27
700			0.25 0.91			Stop core 8:20 AM 12/5/74		
701	~60							
702								2.05 702.82-2.87 } Tuff SS – dk gray
703								3.35 703.08-3.12 } to brn, w. m. gr. lith.
704			704.74 4.92			704.61		Oilshale pyrite, & hycarbons
705								704.74 to 707.80 low grade,
706			6.20 .23 .41			12.00 Rec START CORE 12/5/74		lt brn to buff, f.l.m., med. efferv,
707								Oil Shale, med grade, tan to dk
708			8.33				+ + +	8.85 brn to dk gray lamina – light
709							+ + +	9.15 color zones more highly efferv. th.
710			0.31					dk. Higher grade zones are
711	-70					19.58 Rec/19.97 cut RQD 18.58/19.58		Mahogany to blk.
712								2.4
713								3.56 Tuff SS's { 708.61-8.64
714			4.11					dk gray to { 709.85-8.87
715								dk brn, minor magnetite & hycarbons, etc. { 710.31-710.58
716			6.36					712.33-2.36
717								7.4 715.45 to 717.4 – lt gray to tan
718			8.25					8.8 to lt. brn oil shale, med
719			9.25					9.36 grade, med efferv.
720			0.60 0.64 .04			2:15 PM stop core		Oil Shale (720.6-723.86) – lt. gray to
721	=60		1.08 1.25					buff colored zone, low grade,
722			2.05 2.71					med. lam., med. calc., feel of
723			3.56					3.86 mudstone
724			4.20			724.84		4.77
725			5.78					5.35 tt Tuff SS – 725.67-726.0, lt. brn.
726						START CORE 5:40 PM		6.90 to gray, hycarbons, wavy
727								contacts & bedding
728			8.19				+ + +	8.9 Oil Shale, lt brn, lt. gray, & buff lamina
729								low grade, med calc., med. lam.
730			0.25 0.34					
731						20.00 Rec/20.02 cut RQD = 100		Tuff SS – 728.47-8.53, dk brn,
732								Some hycarbons, magnet.
733			3.18 3.46					
734								
735								
736			6.33					6.70
737								6.96
738			8.84					
739								

CLEVELAND CLIFFS IRON CO. PROJECT: [illegible]

HOLE NO: X-2 SHEET 7 OF ___ DATE: 12/5/74 LOGGED BY: G.D. AHO C.J. HANSON COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
740						stop coring 8:15 PM 12/5/74		Oil Shale – low grade (Same as above
741								
742								
743			3.29					
744			4.24				+++	Tuff ss 744.60-4.71, dk brn,
745						744.84		minor hycarbons
746								Oil Shale – buff, lt. brn, lt. GRAY, thin
747								lamina, mod. calc., low grade, w.
748								minor Hycarbons, pyrite, nahcolite
749								
750								
751							+++	Tuff SS (751.00-1.21), dk brn. w small
752								amt. of bleeding Hycarb
753								754.00
754							▨	755.00
755								
756								
757								Tuff ss (757.22-7.45), dk brn
758								with excessive bleeding Hycarbo
759								Oil Shale shows irregular wavy lamina
760								in following intervals (746.0-748),
761	-120							(750.0-750.25)(756.35-6.71)
762								(762.0-764.05)
763								Nahcolite VUG (763.0-763.52)
764								
765							—	T.D 765.84 (6:30 AM, 12/6/74)
766								

HOLE NO: X-3 SHEET 1 OF ___ DATE: 1/17/75 LOGGED BY: D. Starbuck COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
								.20
320			START CORING 321.00					
21			.47	.83				OIL SHALE - LOW GRADE CALCAREOU
22			.35					
23								
24								" - HIGHER GRADE CALC.
25			.39					" LOW GRADE CALC.
26			.05	.66				
27			.82					
28								
29			.25	.89				" HIGHER GRADE CALC
330		85° FRACTURE						" LOW GRADE CALC.
31								
32			.00					
33								
34			.16			REC 30.64' DJ STARBUCK 5:30 PM	++++	DARK BAND - SILTSTONE 334.16-.2
35			.81					
36								
37		~						OIL SHALE - LOW GRADE CALC.
38		.30						
39	+130	.65	.84		70			
340						CUT 30.[illegible]'		
41			.09					
42			.12					
43			.62					
44			.72					" MEDIUM TO HIGHER GRADE
45								OIL SHL SILT STONE (345.24-.45
46			.24	.94				
47			~~.94~~	.10 .91				OIL SHALE - MEDIUM GRADE Cal
48			.75					
49	+170							

HOLE NO: X-3 SHEET 2 OF ___ DATE: 1-17-75 / 1-18-75 LOGGED BY: D. Starbuck / E.C. Gentzler COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10	ASSAY 20	ASSAY 30	ASSAY 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
350			.15								OIL SHALE - MEDIUM Grd To 350.40
51							351.90				OIL SAT TUFFAC. SS. (350.40-.18)
52											OIL SHALE: LOW GRADE CALCAROUS
53			.20	.90							
54			.83								
55			.78								
56			.80								
57											
58			.29								SS (358.29-.45'
59	+110		.39								
360			.76								OILY SILTSTONE LENS (360.10-.18
61			.65								
62			.20								CALCARIOUS TUF. S.S. (362.05-.35)
63			.83								OIL SAT. TUF. S.S. (363.42-.16)
64											" " " " (365.42-.47
65			.40	.64							
66			.59								
67											
68			.94								
69	+100		.70								
370	—		.86								
71											TUF. WAVY CALCEROUS SS BED (371.45-.94)
72											
73											
74			.00								
75			.98								375-378 OIL SHALE, gray-brown, v finely lam hard - competent with several thin intermittent inclus of tuff.
76											
77			.19								DARK SILTSTONE LENS (377.15-.20)
78			.68								
79	+90										
380			.44								SS, TUFF, dk gy-brn, lined in contacts int. rt. figur. CALCAREOUS SILTSTONE BED with sh at top & undulating at bas. - m - saturated with [illegible] (380.20-.60)
81			.40								
82			.18				382.40				
83			.14								SHALE, lt-med. Brn, silty, mod. calc., to v. hard
84			.15								containing thin altered. tuff SS (gen. oil impreg),
385			.97								v. hard & thinly lam
386			.92								
387											
388			.77								
389	+80										
390			.01 .98								
391											
392											
393											
394											
395			.27, .32								
396			.56								
397			.67								
398			.86								
399	+70		28.51.97								UPPER WAVY BED (399.01-400.00) Contd.

30.50' ①

CUT ~~30.93~~ REC 30.83
D. J. STARBUCK 9:00 PM 1-17-75

① OK

CUT 27.78' — REC 30.26'
12:30 AM - 18 JAN '75 - ECG

COMMENTS: THE EXCESS CORE RECOVERED ON THESE RUNS ... THE EXTRA 30 ... WAS LEFT AT THE BOTTOM OF THE INTERVAL & TREATED ... NOT EXIST. - ECG

HOLE NO: X-3 SHEET 3 OF ___ DATE: 18 JAN '75 LOGGED BY: E.C. GENTZLER COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
400			.32 .60					Oil impreg. & minor Gilsonite
401			.34					
402			.60					
403			.09 .72					
404			.77					
405								
406			.46					
407								
408			.00					
409	+60		.61					
410								
411			.69			42.36		
412						.60		SILTSTONE - MARLSTONE, lt-med brn, thinly lam.
413		.70	.57 .70					to thinly banded, slightly dipping bedding, w/
414		87°						some microfaulting, hard, mod to v. calc.
415		.30						w/ occ layers of py-hem, & a few zones of
416			.15					low grade oil enrichment. Also occ. vugs
417			.33					of Nahcolite (?)
418								
419	+50							
420								
421			.33					
422			.85					
423								
424			.26					
425			.64			CUT 29.74' — REC 30.05' — EC 7:20 AM — 18 JAN '75		
426				.61				
427			.42					
428			.56	.92				
429	+40			.56				
430								
431								
432			.58					
433				.58				
434			.53					
435			.77	.53				
436			.67	.65				
437			.32 .65	.67				
438			~~.47 .63~~	.33 .65				
439	-30		.06 .25 .77	.61 .62				
440			~~.44 .43~~	.66 .63 .26				Small vugs (.02-.05 dia) filled w/ earthy nahcolite(?)
441			~~.44 .57~~	.48 .33		442.10		
442				.14 .50 .66	.86	.70		
443			.65					LOWER MEDIUM GRADE SHALE
444			.07 .63					CREAM TO DARK BROWN - [illegible]
445								OF HIGH GRADE SHALE. [illegible]
46			.91					SAND LAYERED (OIL SATURATED)
47			.35					ARE FOUND IN RUN.
48			.23					
49	+20							HIGHER GRADE SHALE DARKER TO BLK

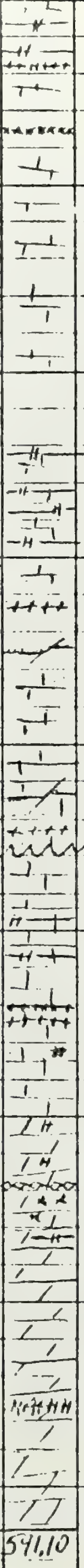
HOLE NO: X-3 SHEET 4 OF ___ DATE: 1/18/75 LOGGED BY: W. Moulton COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
450			.12					
51								
52			.21 .93					MEDIUM GRADE SHALE
53			4 .67 .98					
54			.62 .94					
55			[illegible]					455.00 - 457.00 INNER BEDDED SHALES AN
56						12:30 PM		SANDS - PREDOMINANTLY SANDS
57			.56					SOME ZONES OIL SATURATED
58								
59	+.10							
460			.94					MEDIUM GRADE SHALE
61								
62			.85					
63								
64			.20					
65								LOW GRADE SHALE
66			.72					TO MEDIUM
67								
68			.74			CUT		
69	0							469.52 - .92 MAHOGANY MARKER
470								OIL SATURATED SAND
71				Stuck				10.92 .56
72				472.55				
73			.18 .37 .85					MEDIUM TO HIGH GRADE - BROWN
74			.10 .43					TO BLACK MAHOGANY ZONE
75			.88					INCLUDED IN THIS RUN.
76								
77			.61 .79					
78			.13 .25					
79	-.10							
480								
81			.83					
82	-1.3		.34 .40 .48					
83			.21 .62 .67			REC 36.40 D. START BACK		
84			.89					
85			.22			37.20 1-18-75		
86			.21 .92					
87			.42			CUT		
88			.76					
89	-20		.55			5:30 PM		
490								
91								
92								
93								
94			.50 .82					
95								
96								
97			.03 .10 .12					← SANDSTONE - SILTSTONE (497.62 - .72)
98			.40					
99	[illegible]		.94					

HOLE NO: X-3 SHEET 5 OF ___ DATE: 1-18-75 / 1-19-75 LOGGED BY: D. Stanbuck / E. Gentzler COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
500								OIL SHALE: MEDIUM TO HIGH GRADE
1								"
2								" CALCEROUS
3			.57	loss .80' →				"
4			.97		504.10			"
5			.20	.93				"
6			.34					"
7								
8			.38					SS (508.38-.41)
9	-40		.78					OIL SHALE - MEDIUM GRADE
510			.10	.85				"
11			.13					"
12			.10					"
13			.15					"
14								"
15								"
16						CUT 30.50' REC 30.40 9 PM 1-18-75 D STANBUCK		"
17			.23					"
18		VERTICAL						"
19	-50							"
520								"
21			.12					"
22		523.05	.21					OIL SHALE - MED GRD - CALCARIOU
23		523.73	.73					"
24			.30					"
25			.29					"
26			.26	.53				"
27			.60					OIL SHALE - LOW GRD CALCARIOUS
28			.10	.53 .92				SS – SILTSTONE 528.58-.67
29	-60		.36	.53 .91				
530			.37	.65				
31			.25					
32			.00					
33			.09	.53				SS W/ OILY BANDS (533.53-.97
534			.30	.92	534.60			Siltstone - Marlstone, v.lt-med Brn, occ Gry, thinly lam., hard, mod to v. Calc., w/ some low Grade oil enrichment
535			.46					
536								
537			.70					
538								
539			.15					
540			.81			30.50' CUT – 30.50' REC – ECG 1:08 PM – 1-19-75		
541								
542			.04, .29					
543			.73 .91					
544			.26 .57					
545			.69 .81					
546			.45 .55					Tuff SS (546.72-547.53) Coarse-grnd, oil sat. w/ Gilsonite; containing Marlstone lenses
547			.30 .55					
548			.11 .80				12' air	
549			.02 .12 .93					TUFF SS (548.38-550.00) [illegible]

HOLE NO: X-3 SHEET 6 OF ___ DATE: 11 JAN '75 LOGGED BY: E.C. G[illegible] COLLAR: ____ TD: ____



DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
550								
551			.76					
552								
553			.07					(553.37-.40) Tiny Nahcolite(?) aggs in sh.
554		.73 35° .39	.73					
555			.39					
556			.52					
557			.39					
558			.56					
559			.34					
560		.72 85°	~~.3~~ .72					
561			.76					
562								
563								
564			.78 .89			565.10		
565			.29					Tuff Ss. (566.12-.29), oil Sat.
566		HEALED 55° .45 .50 45° 45°						
567								slightly distort. bed, & bed. offset ~~[illegible]~~ .03' along
568								healed 55° frx.
569	-100		.82					
570		45° .04 .00 45° 45 HEALED						LIMESTONE, lt Gry-Brn, Med grd., thinly lam.,
571								dolomitic in zones., low Grade oil in [illegible]
572			.17					& containing occ. oil bearing tuff Ss. layers.
573			.08					Also pods & lam of Py-hem & occ vugs of
574								earthy nahcolite (?)
575								
576			.00 .73					Tuff Ss (576.98-577.10) & (577.33-.57) is altered,
577			.08 .57					oil stained, & containing nahcolite (?).
578		.57 VERT .72	.57 .72					
579								
580			.41					
581								Intra-formational breccia, (581.92 - 582.00)
582			.53					Vugs of earthy Nahcolite(?) & oil.
583			.25					thin lam. of Py-hem
584			.65			26.00' CUT — 26.?? REC 5:50 AM — 11 JAN '75 — ECG		
585		.57 88° TAR COATED	.06 .93					
586			.60 .82					
587			.90 .96					~~T[illegible]~~ Massive PY-HEM layer (587.90-.96)
588								& its tar coated vert. frx.
589	-120		.90 .94					
590			.74					
591						T.D.= 591.10		

HOLE NO: X-1 SHEET 1 OF 1 DATE: 1-1-75 LOGGED BY: SUNDBERG
FRANCIS COLLAR: ______ TD: ______

FROM	TO	±MM	ASSAY				GAL/TON	DESCRIPTION
			10	20	30	40		
180	190							
	200							
	210							
	220							
	230							
	240							
	250							
	260						L.S	LT. GR. SILTSTONE SLIGHT EFF.
	270						W.R	" "
	280							" "
	290							
	300							LT. GR. SILTSTONE & SS.
300	310							LT. GREY SILTSTONE SLIGHT EFF.
	320							"
	330							"
	340							"
	350							LT GR. FINE GR. SILTSTONE SLIGH EFF.
	360							"
	370							"
	380							LT BROWN SHALE, SOME GILSONITE SLT. EFF.
	390							LT BROWN SHALE
	400							"
400	410							"
	420							LT BR SHALE
	430							"
	440							"
	450							LT. TO MED. BROWN SHALE
	460							" "
	470							LT. TO MED BROWN SHALE SLIGHT EFF.
	480							" " "
	490							" " "
	500							" " "
500	510							LT. TO MED. BR. SHALE WITH MINOR SS
	520							" " "
	530							MED TO DK BR SHALE MINOR WHITE MINERAL (SOFT
	540							LIGHT TO MED BR. SHALE
	550							MED. TO DARK BR. SHALE
	560							" "
	570							" "
	580							" "
	590							" "
	600						L.R.	" "
[illegible]	610						L.S	Med to Dark Br Shale
	620							" " " "
	630							" " " "
	640							" " " "
	650							" " " "
	660							" " " "

THE CLEVELAND-CLIFFS IRON CO. PROJECT: WRS

HOLE NO: X4 SHEET 1 OF 6 DATE: 1-2-75 LOGGED BY: SUNDBERG COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
660			.3-.9				660	OIL Shale Lt br to DK Low grade
661			.58.8					Finally Laminated
662			.2-.6					
663			.12.4					
664			.09					
665			.12					same as above - badly
666			.07.59	.43				broken up - slightly calcareous
667			.4.95					
668			.54.9					
669			.35 .68					
670			.18.15.9	2			Recov - [illegible]	LtBR Low grade, oil shale
671			.34.59	1				slightly calcarous
672			.22.6.81					
673			.15 .43	.18			Core	
674		[illegible]	.53	.2				
675			.06 .16					Same as above
676			.48				30.40' 31.00'	
677			.37					
678			.15 .7					Lt brn to Med brn
679			.15 [illegible]					LT. BRN OIL SHALE (MINOR SS BANDS)
680			[illegible]	2			Cored [illegible]	" "
681			.35 [illegible]					LT BRN TO MED BRN OIL SHALE
682			[illegible] 7					"
683			[illegible] .6					" "
684			.55					" "
685			.26 [illegible]					" "
686			.1					"
687			.65					MED TO LT BRN. LOW GRADE OIL
688			[illegible]	[illegible]				SHALE BADLY FRACTURED DURING
689			[illegible]	[illegible]				DRILLING.
690			.45.23					[illegible]
691								LT TO MED BROWN LOW GRADE OIL
692								SHALE CALCAREOUS WITH FINE
693								LAMINATIONS.
694								LT BROWN LOW GRADE OIL SHALE
695								"
696								"
697								LT BR. OIL SHALE
698								" " .72-.80 SS OIL SAT.
699			.52					MED BR. OIL SHALE
700								MED. BR. LOW GRADE OIL SHALE .18-.3
701			.65					OIL SAT. SS
702								LT BR. LOW GR. OIL SHALE
703			.50					" "
704								" " .85-.90 OIL SAT SS
705			.64 [illegible]					LT BR. LOW GR. OIL SHALE
706								.77-.85 OIL SAT. SS
707	+130		.65					LT. BR. LOW GR. " "
708			.47.9					MED BR. MED GRADE OIL SHALE

CLEVELAND CLIFFS IRON CO. PROJECT:

HOLE NO: X-1 SHEET 2 OF 6 DATE: 2-2-75 LOGGED BY: [illegible] COLLAR: TD:

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
710						Cut 30 FT Recov'd 30 FT		Med Gr. Brn Oil Shale
711								" "
712		.22						Oil Sat. SS. "
713		.31						Lt. Brn Low Gr.
714								"
715		.25						Med Gr. Med. Gr.
716		.56						"
717	+126	.44						"
718								"
719		.18	.55					"
720					720.75			
721								
722								
723								
724								
725								
726								
727	+110							
728								
729								
730								
731								
732								LOST CORE
733								
734								
735								
736								
737	+100							
738								
739								
740								
741								
742								
743								
744								
745								
746		??						
747	+90	.30 .60 .40						Grey with Lt Brn bedding
748		.30 .10						Low to Med oil shale
749		.10 .45	.80					
750			.15 .75 .70			Cut 55 FT Rec 30.5'		Med brn oil shale } slightly calcareous
751			.10 .50 .40					" "
752			.15 .35 .60 .90					" "
753			.48 .47 .77					" "
754			.1 .44 .14 .73					" "
755			.25 .12					" " Low to Med Grade
756			.1 .6 .04					" "
757	+80		.04 .61					SS with Low Grade (.34 - .43)
758			.08 .31 .51 .79					Oil Shale calcareous
759			.21					Med BRN Oil shale

COMMENTS:

THE CLEVELAND-CLIFFS IRON CO. PROJECT: C.R.S.

HOLE NO: X-4 SHEET 3 OF 6 DATE: [illegible] LOGGED BY: Kinnings COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
760			.21		ACCURACY OF CORE IS QUESTIONABLE FROM 772.73 TO 776.60 IN	DUE TO CORE BEING WEDGED IN CORE – LOST APPROX 2.5 FT – CORE JAMMED IN BARREL, EASY BREAKS		MED. BRN SLIGHTLY LAMINATED -
761			.35	.76				OIL SHALE. MED GRADE
762			.32	.4 .32 -				SLIGHT LFF.
763			.7, .5	.76				" "
764			.12 .3	.7				" "
765			.35	.69				" "
766			.36	.7				" "
767	+70		.14	.33 .35				" "
768			.21					" "
769			.65	.72				" "
770			.51					" "
771			.50	.5				MED. TO DARK BRN MED. GR.
772			.35	.71				"
773			.30	.33				"
774			.15					774.67 – 775.37 UPPER WAVY BED.
775			.32	.70				MED TO DARK BRN MED GRADE
776			[illegible]					776.60
777	+60		.33	.51				MED TO DK. BRN OIL SHALE
778			.31					MED GRADE MILD LFF.
779			.32					THIN LAMINATION
780			.40					"
781			.65	.45				"
782			.67					"
783								"
784								MED. TO DK BRN OIL SHALE
785								"
786			.35 .60	.94				"
787	+50		.22 .50	.95				MED. TO DK BRN MED GR. OIL SHALE
788								1/2" DK RICH BANDS COMMON
789								"
790			.41			30.60 FT	RECOVERED 30.20'	MED TO DK. OIL SHALE MED. GR.
791			.25					"
792								LT. TO MED. OIL SHALE LOW GR.
793			.46					" "
794								" " 794.2 SS LENS
795			.50					" "
796						CUT		796.4 TO 796.6. OIL SAT SS
797	+40		.31					LT. TO MED BRN MED. GR. OIL SHALE
798								"
799			.34	.76				"
800			.61					MED TO DK BROWN, HIGH GR. OIL SHALE
801								@ 801 OIL SS LENSES
802			.65	.72				MED BR. MED GR. OIL SHALE
803			.75					" "
804			.35	.5				" "
805			.41	.62				LT. BR. TO BUFF MED GR OIL SHALE
806			.25 .34	.98				805 - 806 VUGGY ZONES WITH WHITE CLAY LIKE MIN.
807	+50		.30, .45,	.63 .55				— 807.20'

COMMENTS: [illegible] is very likely a portion of the upper [illegible]

HOLE NO: X-4 SHEET 4 OF 6 DATE: 1-3-75 LOGGED BY: [illegible] COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	[illegible] DESCRIPTION
808			.55 &	.93				MED. GR. MED. TO HIGH GRADE
809		[illegible]	.82 &	.98				OIL SHALE. FAINT BANDING
810			.37 &	.97				WEAK EFF.
811			.60					"
812			.40 &	.84				"
813								"
814			.90					MED. GR. MED GRADE OIL SHALE
815			.90					FAINT BANDING MARKED BY
816			.80					DK BANDS LOCALLY. LENSES OF
817	+20							SS WITH PYRITE. HIGH GR. ZONES
818			.21					SLIGHT EFF.
819			.10 &	.19			4/0'	MED. GR. MED GR. OIL SHALE
820			.12					" "
821			.50		Mahogany	Marker	[illegible]	.50 - 70 OIL SAT SS HIGHLY DISTORTED
822			.45					822.0 TO 822.45 OIL SAT SS.
823			.31 &	.45			[illegible]	MED GR. TO BUFF MED. GR. OIL
824								SHALE. 823-824 OIL SAT. SS
825			.56					BANDS.
826			.45					825.5 - 827.5 DK. BRN. HIGH GR.
827	+10		.40					OIL SHALE IRREGULAR OIL SAT.
828								SS LENSES.
829								LT. TO MED LOW GR. OIL SHALE
830			.59					" "
831			.75					" "
832								" "
833			.63					" "
834			.67					" "
835			.67					" " — MM
836			.65					836.5 - 837.1 OIL SAT SS [illegible] DISTORTED
837	O		.57					[illegible] SHALE WATERY
838			.24					838.60' banded Lt brn, buff
839			.41					to dk brn Low grade oil shale
840								
841			.27					S.S. Lense Lt brn to buff calcareo.
842								Drk banding Med brn oil shale
843								Lt brn slightly calcareous
844								thinly banding
845			.09					Lt Brn buff Low to Med grade
846								oil shale
847	-10		.54					Drk Brn oil shale
848								Lt Brn to Drk Brn dist bed
849			.67					" " " oil shale
850			.11					Drk Brn twisted bedding oil shale Med
851			.3-.35	.75				Drk Gry oil shale slightly grade
852			.13					Lt Brn oil shale calcareous
853			.52					zone (.83) ?
854			.25-.4	.45				
855								Med brown twist S.S. oil shale
856			.83					" " oil shale
857	+20							Dk brown " "

MM

COMMENTS:

HOLE NO: X4 SHEET 5 OF 6 DATE: 1-4-75 LOGGED BY: SUNDBERG COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
858								Med brn - Med grade oil shale slight
859								" " " " " " oAL
860						30 29.30		" " " " " CHIPPO
861								Lt BRN - Low grad oil shale "
862			.5					" " " " " " "
863		.5	.18					" " " " " "
864			.25			DRILLED Rec		" " with DK BRN bands - oil shale
865		.01	.3					DRK BRN
866		.7	.35 .7					Med Brn Oil shale
867	-30		.55 .9					866.70 Lt Br to Med oil shale
868		.15	.15 .75					S.S. Lense " " " " "
869			.84					" " " "
870								" " " "
871			.24					Lt br - Low grade oil Shale
872								" " " " "
873			.08					Lt br Dk Br Layers SS Lenses
874			.45					Low grade " IN
875								" " this
876			.04					" " Area
877	-40							" " "
878			.66					" " "
879			.46					" "
880								Ltbr / DK BRN Layers thin, Low grade shale oil
881			.08			30		" " " " " " "
882			0					" " " " " " "
883								" " " " " " "
884						DRILLED		" " " " " " "
885								" SS Band .35 " " " " " "
886			.5					Lt brn with DRK BRN layers Low grade oil sha
887	-50							" " " "
888			.36					" " " "
889			.38					" " " "
890			.15					" " " "
891			.1 .83					" " " "
892			.07 .5 .57					" " " "
893			.27					Lt Brn, Med to Low Gr Oil Shale
894			.12					" " " "
895			.17					" " "
896								896.70 " "
897	-60		.33 .5 .45					Lt Brown Low Gr Oil Shale
898			.15					" " "
899			.21					" " "
900			.6					Med Grade Oil Shale
901			.51					" "
[illegible]			[illegible]					[illegible] to [illegible] SS "
[illegible]			.5					Dk Br. High Gr. Oil Shale
[illegible]			.3					[illegible] Oil Sat. Vein. "
[illegible]			13					Med Dk Med. Gr. with Dk Br.
[illegible]			.6					Layers.
[illegible]	+70		[illegible]					" " "

HOLE NO: X-4 SHEET 6 OF 6 DATE: 1-4-75 LOGGED BY: KANGAS COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
908			.34					MED. BR. MED GR. OIL SHALE WITH
909			.32					DK BR. BANDS. 908.80 OIL SAT. SAND
910			.01 & .72					"
911			.38 .59, .68 & .80			CUT 30.00 FT & RECOVERED 30.00 FT.		"
912			.21 .53 & .92					"
913			.16, .66 & .72					"
914			.36, .73, .90					"
915			.65					MED BR. MED GR. OIL SHALE
916			.18 & .75					INT. OIL SHALE & OIL SAT. SS
917	-80		[illegible], .18 & .83					" "
918			.15					LT. BROWN LOW GR. OIL SHALE
919			.09 & .35					919.55 OIL SAT SS .05 WIDE
920			.06 & .42					LT BR. LOW GR.
921			.17 & .32					" "
922			.46					LT BR. LOW GR OIL SHALE
923			.13 & .70					"
924			.52					"
925			.57					"
926			.32 & .37					"
927	-90							926.70 "
928								LT. BR. TO BUFF LOW GR. OIL SHALE
929			.36					WITH DK BANDS
930			.32					LT. BR., LOW GR. OIL SHALE
931								" "
932								" "
933								
934								934.1-934.25 & .50-.70 OIL SAT SS LAYERS
935								LT. BR. LOW GR. OIL SHALE
936			.45					LT. TO MED BR. LOW TO MED GR.
937	-100							" "
938								" "
939			.70					" "
940			.44					940.65 TO .80 OIL SAT SS
941			.40					LT. BR. LOW GR. OIL SHALE
942			.92					"
943			.92					"
944								"
945			.13, .27 & .33					LT TO MED BRN. LOW GR. OIL SHALE
946			.36					OIL SAT. SS AT .80
947	-110							LT. BR. LOW GRADE OIL SHALE
948								" "
949								" "
950		VERT FRX.	.43					"
951			.63					"
952			.90					VERT FRX. COATED WITH OIL
953								"
954			.26					"
955								"
956								
957	-120							"

COMMENTS: • 1 FT. OF CORE LOST BETWEEN 957 & 958. SPLIT CORE HANGING OUT OF CORE CATCHER CORE WHEN [illegible] PULLED

HOLE NO: [illegible] SHEET 1 OF 2 DATE: 1-[illegible]-[illegible]5 LOGGED BY: [illegible] COLLAR: ______ TD: ______

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
0	60				OVERBURDEN
60	70				NO SAMPLE CUTTINGS MIXED WITH CEMENT
	80				
	90				
	100				
	110				
	120				
	130				
	140				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				
	[illegible]				FN GR LT BRN SILTSTONE WITH GREY SAND [illegible]
[illegible]	[illegible]				LT GREY SANDSTONE
	[illegible]				" "
	[illegible]				LT BRN SILTSTONE & GREY SANDSTONE
	[illegible]				LT GREY SANDSTONE
	[illegible]				" " " "
	[illegible]				Lt Grey Sandstone
	[illegible]				" " " " & Lt Brn Siltstone
	[illegible]				" " " " "
	[illegible]				Lt Brn to Med Brn "
	[illegible]				" " "
[illegible]	[illegible]				" "
	[illegible]				Med BRN to DRK BRN SH
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				DK BRN SH with some Med Brn Chips
	[illegible]				" "
	[illegible]				" "
	[illegible]				DK Brn & Med Brn Sh with a Few Grey chip
	[illegible]				" " "
	[illegible]				" " "
[illegible]	[illegible]				Lt Grey SS & Lt Brn to DRK BRN Sh.
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				Lt BRN to DRK BRN with Some Grey chips
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				" " "
	[illegible]				Reddish Brn Cuttings (Fine - Tricone bit grinds)
[illegible]	[illegible]				Brn to Reddish BRN SH, SS Fine GRIND.
	[illegible]				" " " " "
	[illegible]				" " " " "
	[illegible]				" " " " "
540					[illegible]

HOLE NO: XS SHEET 2 OF 2 DATE: 1-7-75 LOGGED BY: RAINEARS COLLAR: ______ TD: ______

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
550	560				RED TO LT BRN SILTSTONE
	570				LT. BROWN SHALE WITH MINOR SS
	580				" " "
	590				LT TO MED. BRN SHALE MINOR SS
	600				" " "
	610				MED. BRN SHALE STRONG EFF.
	620				" "
	630				MED TO LT. BRN. SHALE "
	640				" " "
	650				MED BRN. SHALE MODERATE EFF IN GR.
	660				" " " "
660	670				" " " "
					END OF CHIP SAMPLING. START CORE DRILLING

N : MISTAKE IN DEPTH OF HOLE. CHIP SAMPLES ENDED @ 651.40', LOCATION OF MISTAKE UNKNOWN

HOLE NO: X5 SHEET 1 OF ___ DATE: 7-8-75 LOGGED BY: Sundberg COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
652			.89					TOP 651.4 Lt Grey thinly bedded
653			.25					Lt Grey to Lt brn " "
654								" " " "
655								" " " "
656			.45 .81 .92					" " " "
657								" " " "
658								Lt BRN with dk brn bedding
659								Lt Grey to Lt bRN thinly bedded.
660			.6					" " " Grey SS
661								" " " bands
662								" " "
663			.75					" " "
664								" " " Low Grade
665			[illegible]					Lt bRN - with DRK banding
666			.72					DRK brn to Lt brn & Grey Fine bedding
667			.53					Lt bRN with Grey Lenses SS
668								" " "
669								" " "
670		40°	.42					Lt bRN thinly bedded calcareous
671		.05						" " " "
672			.17			30.50' 30.25'		Lt bRN to DRK bRN
673			.2 .73					LtBRN with some Grey lenses
674			.32 .83					LtBRN thinly bedded calcareous
675								" " " "
676			.47					" " " "
677			.1			DRILLED Rec'd		Lt Grey to buff
678								Buff to DRK BRN oil shale SS BAND with oil .1
679								" " SS Lense .1
680			.89					Lt buff with Grey thin bedding
681	+130		.65 .75					" " " "
682								681.65 Lt BRN DK Fine banding
683								slightly calcareous
684								" "
685								" " with BAND OF
686			.63					" " SS with oil
687								" "
688			.82					" "
689								Lt BRN (buff) to BRN with bands of oily
690								SS. " " " " "
691	+120							LtBRN with DRK bRN bands slighty calcarous
692			.4					DRK BRN SS BANDS with oil.
693			.17					Lt to Med BRN Fine bedding
694								" " " slighty
695			.07 .11					" " " calcarous
696			.19					" " "
697			.36					" " "
698								LtBRN with DRK BRN bedding
699			.28					LtBRN to Med BRN oil shale
700			.79					" "
701	+110							Med BRN / DRK BRN SS oil saturated

HOLE NO: X5 SHEET 2 OF ___ DATE: 1-8-75 LOGGED BY: SUNDBERG [illegible] COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
702								Lt brn to Med brn SS oil saturated
703			.5					″ ″ twisted bedding ″
704								DrK Br SS (saturated oil) .4-.5
705						DRILLED 30.40 Rec'd 30.40		Lt brn to DrK Brn (banding)
706		.4	.64					″ ″ ″
707		.42	.45					Lt Brn to Med Brn with Fine bedding
708								″ ″ Shale with SS oil layers
709								″ ″ ″
710		.5	.35					Lt brn with DrK Brn banding
711	+100	.8						″ ″ ″
712			.07 .42 & .24					712.05
713			.54					Lt. Br Oil Shale with Oil Sat SS .07 To .60
714			.22					Lt. To Med Br. Mottled Oil Shale
715			.10 & .27					Faint Banding Marked By Thin SS
716			.32					Bands & Lenses Med Gr
17			.23					″
18			.35					″
19			.33					″
720			13 & .35					20-.35 Oil Sat. SS ″
21	+90		[illegible]					.62-.72 ″ ″ ″ ″
22			.11 & [illegible]					Few Dk Brn High Grade Bands
23			[illegible]					″
24			[illegible]					″
25		.12	[illegible] .35 .61 & .72			[illegible]		.22-.60 Oil Sat. SS ″
26			40					Lt. To Med Br. Med. Gr. Oil Shale
27								″
28								20-30 Oil Sat SS
29						DRILLED REC'D		
730			.27					.22-.42 Oil Sat. SS. 42-731 High Gr. Dk Brn.
31	+80		43					731-.50 High Gr Oil Shale
32								Med Brn Med Gr. Oil Shale
33			.19					Med To Lt. Brn. Oil Shale Med To Low
34								″
35			.72					″
36			85					.85-.95 SS. ″
37								″
38								″
39			[illegible]					.55-.65 SS Oil Sat.
740			.52					740.52-742.25 Dark Wavy Banded
41	+70		.25					SS.
42			[illegible]					742.28 ″ 742.[illegible] End SS
43								Med Brn Med Gr. Oil Shale
44			[illegible]					A Few Dk Brn Bands
45								″
46			12					″
47								″
48			35					″
49								″
50			07					″
51	+60		14					″

HOLE NO: X5 SHEET 8 OF ___ DATE: 1-8-9-75 LOGGED BY: Kangas SUNDBERG COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
752								MED BRN. MED GR. OIL SHALE
53			.05 .13					"
54								"
55								"
56			.45 .15					"
57			.40 .14					"
58								"
59			.53					MED BRN. MED. GR. OIL SHALE
760			.61					A FEW DK BRN BANDS.
61	+50					DRILLED 10.27' RECOVERED 10.27'		"
62			.03					"
63			.35					"
64								"
65			.16					"
66								"
67			.26{.75					"
68			.4					"
69								"
770		13	.82					"
71	+40		.4 .7					"
72			.55					772.55' "
73			.92					Med Brn, Med Gr Oil shale, a few
74								DRK BRN bands, few ss Lenses
75			.7					" " "
76			.75					" " "
77								" " "
78			.28 .65					" " "
79			.22 .81					Med Brn, Med Gr Oil shale Few DRK
780			MB .11 .14 .63 .58					Brn bands
81	+80		.11 .3 .7					" " "
82			.55					Lt brn, Low Gr Oil shale calcareous
83			.17 .83					" " " "
84			0 .16					" " " "
85			.2 .44					Lt Greybrn with Fine dk brn bedding
86			.08 .69					" "
87			.07 .40 .54					" "
88			.77					" "
89								Lt Greybrn to Lt brn Low Gr shale
790			.95					" " "
91	+20							Lt Brn with Drk Brn irreg bedding ss Lense
92			.09 .57 .91					" " "
93			.09 .69 .42			DRILLED 30.5 Rec'd 29.70		" " twisted bedding
94			.3 .69					" "
95			.2					Lt brn, Med Gr oil shale DRK BRN Bands
96			.1 .75					" " "
97			.55					" " "
98			.83					Med Brn Med Grd Oil Shale
99			.66					" " with oily ss Lenses } MAH MAH
800								Lt Brn with DRK BRN bands
801	+10							" " "

COMMENTS:

THE CLEVELAND CLIFFS IRON CO. PROJECT:

HOLE NO: X5 SHEET 4 OF ___ DATE: 1-9-75 LOGGED BY: Sundberg COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
802			.25 .43					802.25
803			.05					Med brown Med grade oil shale with
804								Dk brn bands & ss saturated oil
805			.9					Med brn, Med gr oil sh. / Dk brn bands
806								〃 〃
807								〃 〃
808								〃 〃
809			.78					〃 〃
810			.64					〃 〃
811	0		.5 .8					SS ~~MAHOG. MARKER~~ 〃 811.48-811.9
812			.9					〃 〃
813								Dk Brn Med gr oil shale
814			.65					〃 〃
815								Med brn, Med grade, with dk brn bedding
816			0.88					〃 〃
817			.05 .72					〃 〃
818			.2 .63					〃 〃
819			.11 .55 .85					〃 〃
820			.07 .58					〃 〃
821	-10							〃 〃
822			0				30.50 29.70	〃 〃
823			.12					〃 〃
824			0 .3 .37 .55 .92					〃 〃
825			.22 .5 .6 .75					Med brn with dk brn bands LIGHT BAND
826			.05 .15 .35 .71					〃 〃
827			.1 .37				DRILLED Rec'd	〃 〃
828			.45 .75					〃 〃
829			.9					Dk Brn Med Grade O. Sh.
830			.9					Med brn with ss lenses & dk brn bed
831	-20		.35					〃 〃
832			.11 & .45					831.95
833			.55					MED TO DK BRN OIL SHALE MED TO HG GR.
834			.66					DISTINCT [illegible]
835			.40					〃
836			.35					〃
837			.10 & .7					
838			.56					[illegible] SS BAND.
839								839.74 [illegible] FRAC [illegible]
840			.67					MED TO DK BRN HG GR OIL SHALE
841	-30							[illegible]
842								BEDDING MARKED BY SS LENSES & BANDS
843								〃
844								〃
845			.06					〃
846			[illegible]					MED TO DK BRN OIL SHALE [illegible]
847			.44					
848								848 1" SS LENS.
849								[illegible] HG GR [illegible]
850			[illegible]					
851	[illegible]							

HOLE NO: X-[illegible] SHEET 2 OF __ DATE: 1-9-75 LOGGED BY: K[illegible] COLLAR: ____ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
852			.23 &	6				MED TO DK BROWN OIL SHALE [illegible]
853			.13					THICK BEDDED MARKED BY SS LENSES.
854			.55			[illegible]		"
855			.30					"
856			.52					"
857			.40					"
858			.15 & .35					
859			.51					"
860			.25 & .4					"
61	-50		.22					"
62								"
63			.50					"
64						—	—	863.56 LOST 1.50' CORE
65			.71					LT BROWN LOW GRADE OIL SHALE
66			.12					THINLY LAMIN.
67								.50 & .70 1/2" [illegible] SS. MED [illegible]
68								"
69			.53 & .4					LT BRN TO MED LOW GR. OIL SHALE
70			.45 & .4					" "
71	-60		.21					" "
72								
73			.33					
74			.45 & 12					.92 - 875.30 SS [illegible]
[illegible]								
[illegible]			.11					.55 .72 OIL SAT. SS
[illegible]			.45					MED BRN MED GR. OIL SHALE
[illegible]						[illegible]		MED BRN MED GR. OIL SHALE
[illegible]			.3					" "
[illegible]			.2					" "
[illegible]	-70		.56					881.50 - 882.56 [illegible] GR. [illegible]
[illegible]			.56			[illegible]		.56 THIN OIL SAT. SS.
[illegible]								" "
[illegible]			.26 .24 .32 & .31					LT BRN LOW GR. OIL SHALE
[illegible]			[illegible]					"
[illegible]			.36					MED BRN MED GR. OIL SHALE
[illegible]			[illegible]					" "
[illegible]			[illegible] & .3					" " THIN
[illegible]			.08					888.70 - 890.30 INT. SS & [illegible] GR. OIL SHALE [illegible] SS OIL SAT
[illegible]								890.30 [illegible]
[illegible]	80							MED BRN MED GR. OIL SHALE
[illegible]			.12					"
[illegible]						25		
8[illegible]			[illegible].54			[illegible]		OIL SHALE (Hew Grade) [illegible] lt-med Brn, finely lam, w/ [illegible]
8[illegible]								layers & spots of Kerog[illegible] & [illegible] tan tuff layers
8[illegible]			.74					layers w/ Nahcolite [illegible]; sltly to [illegible]
8[illegible]								
8[illegible]			.78					
8[illegible]								
[illegible]								
701	[illegible]							

HOLE NO: X-5 SHEET 6 OF 6 DATE: 10 JAN '75 LOGGED BY: EC GENTZLER COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
902			.20				H	
903							H H H	~~[illegible] mod grade, and low~~
904							H	Med. Grade layers
905		30°						OIL SHALE, low-Med. Grade, Med. Brn (905.9-923.2)
906		[illegible]	.20					MISSING CORE (906.20-.30)
907		VERT						High Grade Zone (oozing oil)
908		.10						
909			.88					Tuff. Ss layer (909.53-.55) w/ minor Nahc.
910		70° HEALED						Med-High Grade Zones (layers)
911	-100	.55						
912						30.30' CUT / 30.30' RECV 12:20 AM, 10 JAN '75 ECGENTZLER		
913			.28 .63					
914								Nahcolite, as disc. layers in rich oil sh. [illegible]
915			.00 .33					(Disregard this)
916								Slightly-med. calc.
917			.?4					
918			.07					
919			.25 .[illegible]					
920								
921	-110						H	
922								
923		Vert	.13 .7?				H	
924		.66	[illegible]			924.30	H	SHALE, silty, (923.20 - TD.) lt. gray-brn, thin to mostly
925							H	lam., non calc., Hard, num. Hem-py pods.
926			.75				H	
927		45° HEALED	.45				H	
928			.91			11.30' CUT / 11.30' REC 4:00 AM 10 JAN 75 ECG	H	
929								
930			.45				H H	
931	-120		.77				H	
932			.19				H H H	
933			.72					
934			.82					
935						935.30		
936								TD = 935.30'
937								

HOLE NO: X-6 SHEET 1 OF 1 DATE: 1-12-75 LOGGED BY: D. Starbuck COLLAR: ______ TD: ______

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
232$^{(2)}$	242$^{(2)}$			✳	Dark oil Shale
242$^{(2)}$	252$^{(2)}$				"
252$^{(2)}$	262$^{(2)}$				Dark oil shale with minor silt-Sandstone bedding
262$^{(2)}$	272$^{(2)}$				" "
272$^{(2)}$	282$^{(2)}$				Dark oil Shale
282$^{(2)}$	292$^{(2)}$				" Started hitting moisture
					at ~ 289 ft - Low Recovery
292$^{(2)}$	302$^{(2)}$				No Recovery
302$^{(2)}$	312$^{(2)}$				Dark oil shale
312$^{(2)}$	322$^{(2)}$				"
322$^{(2)}$	332$^{(2)}$				"
332$^{(2)}$	342$^{(2)}$				"
342$^{(2)}$	352$^{(2)}$				"
352$^{(2)}$	362$^{(5)}$				OIL SHALE, V. dk Brn, brittle, silty calc
360	370				do (Brief, low flow of water @ ± 369)
370	380			✳✳	do, occ. v.f. musc., V calc
380	390				do
390	400				SHALE, do, SILTY, V. calc
400	410				do
410	420				do
420	430				do
430	440				do
440	450				do
450	460				do
460	470				do
470	480				do
480	490				do
490	500				do
500	510				do

RE BELOW THIS DEPTH

no screens to collect samples

HOLE NO: Y-1 SHEET 1 OF 7 DATE: 1/18/75 LOGGED BY: W. Moulton COLLAR: ____ TD: ____

	DEPTH	±MM	FRX	PP	ASSAY 10	20	30	40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
DJS	510									510.10'		Oil shale - Dark - calcerous.
	11			.12								-do-
	12			.22								-do-
	13			.30								-do-
	14			.18	.73							-do- (514.41' - 514.52' non
	15			.70								-do- uniform sandstone bed)
	16											-do- (515.70' - 515.73' ss)
	17			.10								-do-
	18			.25	.75							-do-
	19			.88								-do- - Light - calcerous
	520											Oil shale Dark
	21											Oil shale Dark
	22			.61								ss w/ dark oilshale beds
	23											ss calcerous w/ lt. oil shale
	24											-do-
	25			~~.41~~								-do-
	26			.68						Drilled 30.66' / Recovered 30.58'		-do-
	27											ss, calcerous w/ dark oil shal
	28											ss, calcerous w/ light oilshale band
	29											-do- (528.50 - 528.55
	530			.00	.07	.69						-do- non calc drk ss,
	31											-do-
	32			.41								
	33											
	34											
	35			.12	.49						SILTSTONE	ss, calcerous w/ dark oil shale ban
	36											-do-
	37			.20								-do-
	38			.50								-do-
	39			.73						540.70		ss, calcerous (w/ light oil shale
DJS	540			.63			540.70					-do- in fine bands)
	41											~~-do-~~
	42											
	43			.12								OIL SHALE LOW TO MED GRADE
	44											CREAM TO MED BROWN SOME
	45											SAND LAYERS OIL SATURATED
	46											
	47			.24	.13							
	48			.51								
	49											548.3 .36 SAND LAYER OIL SATU

HOLE NO: X-6 SHEET 2 OF 9 DATE: 14 JAN '75 / 15 JAN '75 LOGGED BY: EL GENTZLER / W. [illegible] / D.J. STARBUCK COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
550			.57					LOW GRADE OIL SHALE
551	+130							
552								
553								
554								
55 [556			.6					
557								557.00-.20 OILSATURATED SAND LENS.
558								
559								
560								
561	+120							
562			.29					562.75-.35 OIL SATURATED SAND LAYER
563								
564								
565								
566			.37					
567			.37					LOW GRADE SHALE
568								
569						W		
570			.70			W M		570.45 – 571.03 SAND LAYER w/ contorted
571	+110	VERTICAL .65 – .00	.03	.98 571.06		D S		571.58 silt lenses. 571.73-571.8
572			.45					discontinuous sand layer
73			.31					573.31-.35 coarse sand layer, 573.65-57
74			.05					sand-silt bed w/ vertical healed fractur
75			.03	.81				
76		VERTICAL .02 – .48	.57					Medium grade oil shale
77			.10	.48		D		577.02-.48 Coarse grained ss laye
78			.48			S		+ oil saturated + vertical fracture
579			.48			E		SHALE, silty, med-dk Brn., (Mod to) v. Calc
580			.15 .44			G		w/ numerous, scattered CaCO₃ pisolites; occ pyr
581	+100		.35 .59					Hem.; much biotite.
582			.11 .47 .73					SS (Tuffaceous), (582.20-.51), oil impreg., w/ sev.
583			.53					contorted, sh layers. do (583.23-.28)
584			.28 .81 .98					
585			.44 .92					
586			.42					
587			.89					
588			.41					pp. ~~coated~~ coated w/ biot. & siderite (?).
589			.12 .90					
590			.71					SS (Tuffaceous), (590.02-.21), altered, oil sat.
591	+90		.96					do (591.48-.91)
592		.73	.73					
593		VERT	.66					
594		.65	.65					
595			.50					
596			.68					
597			.17					
598		.60	.02					
599		Vert	.95					Ss (Tuffaceous) (599.95-600.00) w/ Gilsonite Bld

1/14/75 CUT 36' [illegible]

REC. 30.70, RQD. 31.44 (ground up 1.04 of broken material)
1-14-75 D. Starbuck 10:30 PM

HOLE NO: X-6 SHEET 3 OF 7 DATE: 15 JAN '75 LOGGED BY: E.C. GENTZLER COLLAR: ______ TD: ______

[illegible] THAT 4.30' SHOULD BE SUBTRACTED FROM ALL FOOTAGE [illegible] ELEVATIONS BETWEEN 633 & 644.5'! [illegible] FOOTAGES WERE NOT ADJUSTED ACCORDINGLY BY WWM. ALL DEPTHS ARE TO LARGE BY 4.30' (LEGEND [illegible])

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
600		vert.						
601	±80					602.50		} LOST CORE (601.46-602.50)
602						(4.30' ASSUMED LEFT ON BOTTOM)		
603								
604								
605								UPPER WAVEY BED [illegible] (605.9-608.[illegible]
606			.10					TUFF. SS, highly altered & contorted, silty calc.
607			.03					
608			125° .77					
609								
610								
611	+70							
612			.95					
613								
614								
615								
616								
617						26.[illegible]' REC — ECG		
618			.17					
619								
620		.55						
621	+60	vert.				5:30 AM - 15 JAN '75		
622	[illegible]	.84						
623								
624		.33	.43					
625						30.50' CUT		
626								
627		.33	.13					
628		.33	.66					
629								LOST CORE (presumed left on bottom)
630								
631								
632				628.66	633.00	633.[illegible]		SEE NOTE ①
633								LOW GRADE OIL SHALE WITH SMALL ZONES
634			.33					OF MEDIUM TO HIGH GRADE
635								SHALE - CREAM TO LIGHT BROWN
636								AND SOME SMALL ZONES OF DARK
637			.3?					BROWN.
638								
639			.40					
640								RICHER SHALE ZONE
641								
642			.4					
643								
644			.62	26.16'		CUT 30.[illegible] REC 30.[illegible] 1/15/75 [illegible]		
645			.58					
646			.30					
647								RICHER SHALE ZONE
648								
[illegible]			.57					

HOLE NO: X-6 SHEET 34 OF 9 DATE: 1/15/75 LOGGED BY: ________ COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
				628.66				
628								LOW GRADE OIL SHALE WITH
629			.23					SMALL ZONES OF MEDIUM TO HIGH
630								GRADE – CREAM TO LIGHT BROWN
31	450							WITH ZONES OF BLACK
32			.30					
33								
34			.20					
35								
36						[illegible]		RICHER SHALE ZONE
37			.14					
38						638.34		
39			.12					
640			.15					
41	440		.30			[illegible]		
42								
43								RICHER SHALE ZONE
44			.57					
45			.65			[illegible]		
46								RICHER SHALE ZONE
47			.50					
48			.75					
49			(.35)25/(.36)					

HOLE NO: X-6 SHEET 11 OF 7 DATE: 1/15/75 LOGGED BY: W. Martin COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC & RQD	LITH.	DESCRIPTION
650			.74.					
51	+30		.63					
52			.25					SILTSTONE BUFF WITH
53			.67					NUMEROUS PP'S
54								
55			.10					MARLSTONE, LIGHT GRAY, HARD
56								CALCAREOUS
57			.72					
58			.55					
59			.17	50 659.40		—		
660			.65					
61	+20		.52					OIL SATUR 661.52 – .90
62								
63			[illegible].66					
64			[illegible]					
65			.19					SANDSTONE LAYERS
66			.06					OIL SATURATED
67			.10 85					
68								
69			.65					
670								
71	+10		.75					
72								
73			.12					
74								LOW TO MED GRADE
75			.33					SHALE
76								
77								
78								
79								
680								
681	0							681.57 681.90 MAHOGANY MARKER
82			.04					SANDSTONE LAYER, OIL
83								SATURATED [illegible]
84			.73					[illegible] SOME INTERBEDDED SHALE
85								
86			.05					SANDSTONE LAYER OIL SATURATED
87								
88		I	.05					HIGHER GRADE SHALE
89			12.70	57	[illegible]			
[illegible]								
[illegible]	-10							

DRILLED 30.0 FT.
RECOVERED
RECOVERED 30.0 FT.

HOLE NO: X-6 SHEET 4B OF 7 DATE: 16 JAN '75 LOGGED BY: ECGENTZLER COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
689						689.[illegible]		SHALE, lt to med Brn (dk Blk-Brn in oil rich zones) silty, finely laminated, v. Calc., w/ med to high grade oil sh zones, occ thin lam of nahcolite & occ thin py to 1cm. dia rds. Also thin tuff ss layers (~~[illegible]~~).
690			.13.31 .24.27			[illegible] + 14 Jan '75 − ECG		
691								
692			.56					
693			.62					
694			.37.47					
695			.71					
696			.15.26					
697			.43					
698								
699			.13.15.27					

HOLE NO: X-6 SHEET 5 OF 7 DATE: 16 JAN '75 LOGGED BY: E.C. GENTZLER COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
700								thin tuff ss layer (.05') 700.2'
701			.81					
702								
703								
704								
705			.38					
706			.37					
707								
708			.77			30.47' REC.		thin (<.05') irregular layer of tuff. ss
709			.47					
710			.09					
711			.22					
712						30.50' CUT		
713			.96					
714								
715			.80					
716			.40					
717								
718			.80					
719						720.40		
720			.04 .13					LOW TO MEDIUM GRADE SHALE
721			.14					WITH A FEW SAND LAYERS,
722			.11		DRILLER CHECKED HIS NUMBERS DOWN	(0.78' ASSUMED LEFT IN BOTTOM)		AND LENS. CREAM COLORED
723								TO MEDIUM BROWN WITH SULFID
724								MINERALS FOUND IN SANDS.
725			.27					
726								
727								
728								
729								
730			.94					
731			.49					
732								LOW GRADE SHALE BUFF TO
733			.92					LIGHT BROWN
734								
735								
736			.57			CUT 30.00' — REC 30.22' 7:25 AM, 16 JAN 75 — ECG		
737								
738			.68 .93					
739			.63					
740			.29					
741								
742			.35					
743					[illegible]			
744			.55					743.92 - 744.2' SAND LAYER (OILSATUR
745			.79					
746								
747								
748			.38					
749			.19					[illegible]

HOLE NO. X-6 SHEET 6 OF 7 DATE: 1/16/75 LOGGED BY: W. Moncton COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC & RQD	LITH.	DESCRIPTION
750			.56	750.90				HIGHER GRADE ZONE
51								
52								LOW TO MEDIUM GRADE SHALE
53			.02 .25 .5 .78 .55					WITH ZONES OF HIGH GRADED
54			.22 .55 .05		SILT SAND			LIGHT BROWN TO BLACK -
55			.18 .54 .91					INNERBEDDED SS AND SOME
56								SILTSTONES -
57			.03 .20 .75 .49					HIGHER GRADE ZONE INNERBEDDED
58			.13 .3 .77					WITH SAND LAYERS SOME
59			.15					DEAD OIL PRESENT
760								
61			.00 .60			30' LEFT ON BOTTOM		
62			.07 .50					LOW GRADE SHALE
63			.04 .30					
64								
65			.43					
66			.26 .66					
67			.44					
68								
69			.17					
770						RAN 30.20 1:00 PM 1/16/75		
71			.35					
72								
73			.51					
74			.73					775.50 - 776.00
75			.84			CUT 29.50 1/16/75		OIL SATURATED SAND LAYER
76								
77								
78			.60 .93					
79								
780				780.10				
81								
82			.78					LOW TO MEDIUM GRADE
83								SHALE SOME OIL SATURATED
84			.83					SANDY AREAS PRESENT.
85			.36 .83					LIGHT TO MEDIUM BROWN
86			.43 .65 .93					HARD
87			.23					SANDSTONE LAYER OILSATURATED
88						DRILLED 23.3 FT. RECOVERED 23.3 FT		
89			.95					
790								
91			.5					
92			.15					
93			.20 .53					
94								
95								
96			.51					
97			.89					
98								
99			.44					

HOLE NO: X-6 SHEET 7 OF 7 DATE: 1/16/75 LOGGED BY: D STARBUCK [illegible] COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
800			.84					LOW GRADE SHALE
01			.81					
02			.44					
03			.50					
04								
05				805.03'				
06								END HOLE 805.03
07								
08								

HOLE NO: X-9 SHEET 1 OF __ DATE: 14 DEC '74 LOGGED BY: N.R. BURNE COLLAR: __ TD:

FROM	TO	±MM	ASSAY				GAL/TON	DESCRIPTION
			10	20	30	40		
0	26							OVERBURDEN
26	30							SANDSTONE LT BRN TO LT GRY SLTLY CALC SOME BIOTITE
30	40							SANDSTONE LT BRN TO LT GRY MOD CALC f-gnd
40	50							SANDSTONE LT GRY SLTLY CALC, ~~Mod~~-f.gnd
50	60							SAME AS ABOVE V.f.-gnd
60	70							SANDSTONE LT BRN TO LT GRY MOD CALC, f-gnd.
70	80							SANDSTONE LT BRN TO LT GRY V. CALC, f-gnd.
80	90							SAME AS ABOVE, V.f-gnd
90	100							SANDSTONE LT BRN TO LT GRY SLTLY CALC, f-gnd
100	110							SAME AS ABOVE, Vf-gnd
110	120							SANDSTONE LT GRY SLTLY CALC, f.-gnd
120	130							SANDSTONE LT GRY MOD CALC, f-gnd
130	140							SAME AS ABOVE, V.f-gnd
140	150							SANDSTONE LT BRN TO LT GRY SLTLY CALC V.f-gnd
150	160							SAME AS ABOVE V.f-gnd
160	170							SANDSTONE LT BRN TO LT GRY MOD CALC V.f-gnd
170	180							SANDSTONE LT BRN TO LT GRY SLTLY CALC V.f-gnd.
180								

HOLE NO: 9 SHEET 1 OF ___ DATE: 1/4/75 LOGGED BY: [illegible] COLLAR: ______ TD: ___

FROM	TO	±MM	ASSAY				GAL/TON	DESCRIPTION
			10	20	40	40		
170	180							NO SAMPLE TOO MUCH CEMENT MIXED
180	190							" " WITH ROCK
190	200							" " " " "
200	210							VERY FINE DUST TYPE MATERIAL
210	220							" LIGHT GRAY TO DK. BROWN
220	230							"
230	240							"
240	250							"
250	260							"
260	270							VERY FINE DUST TYPE MATERIAL
270	280							" DARK BROWN TO REDDISH
280	290							" BROWN
290	300							" (AQUIFER [illegible] CONTACT BETWEEN SS & SH)
300	310							" DRILLING RATE SLOWED DOWN SHALE?
310	320							"
320	330							NO SAMPLE (ABOVE H2O ZONE IS CARRYING CUTTIN
330	340							" "
340	350							" "
350	360							" "
360	370							" " [illegible]
370	380							" " [illegible]
380	390							" "
390	400							SS & SH LIGHT GRAY TO GREEN & REDDISH [illegible]
400	410							" " " " "
410	420							" " " " "
420	430							" "
430	440							SH - DARK BROWN TO REDISH BROWN
440	450							"
450	460							" VERY FEW CHIPS AS BIT
460	470							" GRINDS THE MATERIAL TO
470	480							" VERY FINE.
480	490							"
490	500							"
500	510							"
510	520							"
520	530							"
530	540							"
540	550							"
550	560							"
560	570							"
570	580							"
580	590							"
590	600							"
6[illegible]								"

HOLE NO: X 9 SHEET 2 OF ___ DATE: 1/5/75 LOGGED BY: L. SUNDBERG COLLAR: ___ TD: ___

FROM	TO	±MM	ASSAY				GAL/TON	DESCRIPTION
			10	20	30	40		
610	620							SH - DARK BROWN TO REDISH BROWN
620	630							" " "
630	640							" " "
640	650							" " "
660	660							" " "
660	670							" " "
670	680							" " "
680	690							" " "
690	700							SH CHIPS DK BROWN
700	710							" FINE CHIPS DK BRN.
710	720							" " " " "
720	730							" " " " "
730	740							" " " " "
740	750							SH DK BRN FEW CHIPS - FINE GRIND
750	760							" " " NO CHIPS - " "
760	770							" " " " " " "
770	780							" " " " " " "
780	790							" " " " " " "
790	800							" " " " " " "

HOLE NO: X-5 SHEET 1 OF ___ DATE: 1/6/75 LOGGED BY: W. MOULTON COLLAR: ____ TD: ____

ADD 16 TO ALL NUMBERS

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
300	+127							OIL SHALE LOW TO MEDIUM GRADE
01	–	98	.14					WITH A FEW ZONES OF HIGH GRADE
02			.00 .41					LIGHT TO MEDIUM BROWN - H.G.
03			.07 .35					BLACK - SAND LAYERS PRESENT
04			.11					BUT THIN
05			.31					
06			.55					
07	+120							307.0-.2 SANDLAYER WITH SULFIDE MINER
08			.72					
09		98						
310			.36 .91					310.3-.82 HIGHER GRADE ZONE BLACK
11			.28					
12								
13								
14								
15						CUT 300' (300-330.25') 100% 1/6/75 W MOULTON		
16								
17	+110		.85					317.35-.319 HIGHER GRADE ZONE DRK. BRN
18								
19								
320								320.4-.55 SAND LAYER
21								
22			.16					322.55-323 SANDLAYER OIL SATURATED
23								323.17-.37 " "
24								
25								
26			.32					326.00-.26 SANDLAYER ~~OIL SATURATED~~ SULFIDE MINER
27	+100							
28								
29			.35		330.28			329.00-.20 SANDLAYER SULFIDE MINER
330								330.65-331.1 " " OIL SATURATED
31								
32								
33								LOW GRADE OIL SHALE
34			.00					
35			.69					
36								
37	+90		.1					
38								338.65-.9 SANDLAYER OIL SATURATED
39								
340						RUN 330.25' 1/6/75 W MOULTON		340.00-.35 SANDLAYER OIL SATURATED
41								
42								
43								
44								
45			.46					
46								
47	+80							
48			.23					
49		98	.53					

HOLE NO: X-9 SHEET 2 OF ___ DATE: 1/7/75 LOGGED BY: W. Moulton COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
850		T 90	.9					LOW TO MEDIUM GRADE SHALE
51								
52								
53								
54			.47					
55			.42					
56								
57	+70							857.85 - 859.75 UPPER WAVY BED
58								~~[illegible]~~ CONTORTED, OILSATURATED
59								SANDLAYER
860			.55	860	.53	—		860.53 - 861.5 HIGHER GRADE ZONE DRK BR.
61								
62								
63			.05					
64								LOW GRADE SHALE HARD + HEAVY
65								
66								
67	+60							
68								
69								
870						[illegible]		
71			[illegible]					
72		90°	.01					
73								
74			.35					
75								
76								
77	+50		.17					
78								LOW TO MEDIUM GRADE SHALE
79								
880								
81								
82		45°	.52					HIGHER GRADE ZONE 882-884
83								
84								
85								
86								MEDIUM GRADE ZONE
87	+40		.00					
88								
89			.35	STOP				
890								
91								LOW GRADE SHALE WITH SOME
92								← RICHER ZONES - SMALL
93								
94			.76					
95			.17					
96								
97	+30		.55 1.70					
98			.38 60					
99								WHITE UV, FILLED MATERIAL

HOLE NO: X-9 SHEET 3 OF ___ DATE: 1/7/75 LOGGED BY: W MOULTON COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
900			.07					
01			26.62					LOW GRADE SHALE
02								
03			.83					
04			.10					
05								
06								
07	+20					CUT 3.00' REC 3.51' 1/7/75 [illegible] W. MOULTON		907.5-908.5 HIGHER GRADE SHALE
08								
09			.51					909.75-910.1 CREAM COLORED SAND LENS
910			.					SULFIDE STRINGERS PRESEN
11			.06					
12			.25					
13			.11 .51					913.11-.51 SAND LAYER OIL SATURA
14								
15			.32					
16								
17	+10		.93					HIGHER GRADE SHALE
18								
19			.69					
920								
21			.22	921.22				
22			.2					LOW TO MEDIUM GRADE SHALE
23								IN UPPER PART OF RUN - (MAHOGAN
24								ZONE) HIGH GRADE IN MIDDLE
25								AND LOWER PART OF RUN
26			.80	MM →				926.75-927.2 MAHOGANY MARKER
27	0	.00	31.57 .83					NOT TYPICAL - NOT OIL SATURATED
28			21.50					CREAM COLORED.
29								
930		.	.49					
31			.34					HIGHER GRADE ZONE
32								
33			.63			CUT 3.0' REC 3.67 1/7/75 W. MOULTON		933.2-.4 SAND LAYER OIL SATURATED
34								934 START ~~AA~~ HIGH GRADE ZONE
35			.73					MAHOGANY ZONE
36			.47					
37	-10		.41					
38			25.90					
39			14.77 .93					
940								
41			40.52 [illegible] 92 (corrected)					[illegible]
42								
43		.	.27					
44			.					MEDIUM GRADE SHALE
45			.17					
46								
47	-20							
48				← 1.57 e				948.65-.75 SAND LENS
49				[illegible]				

A: ACCORDING TO DRILLER DEPTH AT 932
IS 2.11' - SAY FROM (947 TO 9[illegible])

HOLE NO: X-C1 SHEET 4 OF ____ ~~DATE:~~ LOGGED W. MOULTON ~~LOGGED BY:~~ DATE: 1/8/75 COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10	20	30	40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
950										X	LOST CORE
51								951.00			" "
52											952 - 956 HIGH GRADE ZONE
53											DK.BR. TO BLACK
54											
55											
56											LOW TO MEDIUM GRADE
57	-30										
58											
59											959-962 HIGHER GRADE ZONE
960			.73								BANDED DK BRN TO BLACK
61			.96								
62											
63			.58								LOW TO MEDIUM GRADE
64			.05								
65			.22 IRR								
66											
67	-40										
68											
69											
970			.26						CUT 31 → BOX 31 1/8/75 12 [illegible] W MOULTON		
71											
72											
73			.31								
74											
75											
76			.7								LOW GRADE SHALE
77	-50										
78											
79											
980			.7								
81											}
82											} PEBBLE ? (BREAKS MECH.)
83								983.00			}
84			.13 .34								
85											
86			57.85								986.7-.92 SAND LAYER OIL SATURATED
87	-60	I 90	.30								987.3-989 HIGHER GRADE ZONE
88											DRK BRN TO BLACK
89											
990											LOW GRADE SHALE
91											CREAM COLORED TO LIGHT BROWN
92			.13 .19								
93											
94			.16								
95			.51								
96			.12 AR								
97	-70		.00 .24 .5 .73								
98			.36								
99											

HOLE NO: X-C1 SHEET 2 OF __ DATE: 1/9/75 LOGGED BY: W. MOLLTCH COLLAR: _____ TD: _____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1000			.06 .71					LOW GRADE SHALE
01			.37 .77			RQD 33.70 1/9/74 4:00 PM W. MOLLTCH		CREAM COLORED TO LIGHT BROWN
02			.32 .50					1001.37-1002.50 SAND LAYER - INNER
03			13 .50					BEDDED SHALE
04								
05			.31					
06			.63					
07	-80							
08			.65					LOW GRADE SHALE
09								CREAM COLORED TO
1010			.36					LIGHT BROWN
11								
12				(1013.83)				
13			.33	1013.33				(LOST .50' FOOT BOTTOM OF HOLE)
14								
15								LOW GRADE SHALE WITH ZONES
16								OF OOZING DEAD OIL - THICK
17	-90							IN SAND LAYERS - THINLY
18			.53					BEDDED
19								
1020								
21								
22			.57					1022-1025,
23			.71					
24			.25			RQD 30.20		1023-1025 OOZING OIL ZONES
25								
26								
27	-100							
28								LOW GRADE SHALE
29			.53					
1030			.37 .85					1030.37 - .50 SAND LAYER OIL
31								SATURATED
32								
33								
34								
35								LOW GRADE SHALE
36								
37	-110							
38								
39			.77					
1040								
41								
42			.53 .81					
43			.42 .45	10‸3.33				
44								LOW GRADE SHALE WITH ZONES
45			.57 .67					OF MEDIUM TO HIGH GRADE
46			.42 .62			RQD 847'		CREAM COLOR TO DARK BROWN
47	-120							TO BLACK.
48			.37					
49			.1					HIGHER GRADE ZONE

HOLE NO: X-9 SHEET 6 OF ___ DATE: 1/9/75 LOGGED BY: W. Moulton COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1050			42				▤	
1051							▤	LOW GRADE SHALE
1052	-R5			1052.00			▤	
		END HOLE						

PROJECT: [illegible]

HOLE NO: X-10 SHEET 1 OF 2 DATE: 12/19/74 LOGGED BY: NHB COLLAR: 5495 approx. TD: 840 plugged

FROM	TO	±MM	ASSAY 10	20	30	40	GAL/TON	DESCRIPTION
0	6							Overburden
6	10							Silty sandstone, light brown, wk-med effer, fine black sp
10	20							Sandstone, lt brn, siltstone, lt brn to green, few thin layers white ls.
20	30							Ss, lt-dk brn; silty ss & siltstone, lt. brown; minor sh, wkly effer.
30	40							Ss & siltstone, lt-med brown, wkly effervescent
40	50							Silty ss & shale, med grey to minor lt brn, moderately effer.
50	60							Ss & silt, lt-med brn & grey, mod effer., pyrite fleck
60	70							Sandstone, lt brn - lt grey, wk-med effer, fine blk fla
70	80							Sandstone, lt-med grey, zero-wk effer, fine black flecks
80	90							Ss & siltstone, lt grey - lt brn, some dk grey, wk-med effer
90	100							Sandstone, lt-med grey, minor lt-dk brn, some wk effer.
100	110							Ss, lt grey, minor lt. brn., non-calc, minor euhedral py.
110	120							Siltstone, lt grey, minor lt grey ss, non-calc.
120	130							Ss, lt grey, fine gr., non calcareous.
130	140							Ss, lt grey, minor lt brn, non-calc., very fine gr
140	150							As above
150	160							Ss & siltstone, lt-med grey, wk-med calc; minor lt brn s
160	170							Ss, lt-med grey, non-med calc., fine grained
170	180							Siltstone, lt-med grey, non-wk calcareous
180	190							Ss, med grey, v. fine gr., non-calc.
190	200							Ss & siltstone, med. grey, some wkly calc, ss v f g
200	210							Ss, lt-med grey, & siltstone, brn-grey, latter wk calc, ss v
210	220							Ss, lt-med grey, vf gr, some siltstone, grey-brn, minor wk calc
220	230							Ss, lt grey, med grey silt, non-wk calc., minor lt brn ss, f
230	240							Siltstone, lt grey, wkly calc.
240	250							Siltstone & ss, lt gray, non-wkly calcareous.
250	260							As above, ss v.f. gr, few small spherical cavities
260	270							Siltstone, lt grey, non-wkly calc. lt brn. spots in p
270	280							Ss, v.f. gr & siltstone lt-med grey, minor lt. brown, v. silt, tiny ch
280	290							Ss & siltstone, ss v.f. gr, lt grey-grey brn. lt gray shale, non-cal
290	300							Ss, v.f. gr, med. grey, mod calc.
300	310							As above
310	320							As above. Moisture @ 315, very slight
320	330							Ss as above, non-calcareous
330	340							Sandstone, v. fine grained, med. gray, non-calc.
340	350							Ss, v.f. gr., gray-brown, non-wkly calc.
350	360							As above
360	370							Silty ss, lt brn-grey, non-calcareous
370	380							As above
380	390							Silty ss, lt. brn-grey, wkly. calcareous
390	400							Ss, grey-brn - grey green, v.f. gr & lt-med. brn. sh, latter m calc
400	410							Siltstone, lt brn, med. calc., minor ss as above
410	420							Shale, lt-med brown, non-calcareous
420	430							Sh, lt-dk brn & lt grey-green gray, non-calc.
430	440							Sh, lt-dk brn & lt grey siltstone, latter mod-strongly cal
440	450							As above
450	460							As above
460	470							Sh, lt brn - lt grey-brn, non-calcareous
470	480							Shale brown to gray-brown, non-calcareous

HOLE NO: X-10 SHEET 2 OF 2 DATE: 12/20/79 LOGGED BY: NHB COLLAR: 5495 approx TD: 840 plugged

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
480	490				Shale dk. brn, some lt. gry - green grey silt, strongly ca
490	500				Sh, lt. - med brn, & siltstone, green-grey, with small; lenses
500	510				Sh, lt. - dk. brn & light grey, minor lt. grey silt, non-calc
510	520				Sh, dk. brn & lt. gray siltstone spheroids non-calc.
520	530				Sh, dk brn, minor lt grey siltstone, wkly calcareous
530	540				As above
540	550				Sh, dk. brn, & siltstone, lt. grey, latter porous & wk-med calc
550	560				Sh, dk - lt. brn, minor siltstone, lt. gray, slightly calc
560	570				Sh, dk brn, lesser siltstone, lt. grey to gray grn, mod.
570	580				Sh, lt - dk brn, & siltstone, lt. grey, strongly calc
580	590				Sh lt - dk brn, strongly calc. (marlstone (?)
590	600				Sh mainly dk. brn, but variegated from white to lt. grn. & pink. Calcar
600	610				Sh, lt - dk brn, lesser siltstone, lt. gray, non-slightly calc
610	620				Sh lt - dk brn, & siltstone, v. lt. brn, non calcareous.
620	630				As above
630	640				As above.
640	650				Sh, brn - blk, ss, v. f. gr, light grey, non-calcareous
650	660				Sh, med - dk brn, w some siltstone, lt. gry, non-cal
660	670				Sh, lt - dk brn, & siltstone, lt. grey, spheroidal con., mod calc
670	680				Sh, as above, w minor siltstone, as above
680	690				Sh, lt. - dk brn, slightly calcareous
690	700				Sh, as above
700	710				Sh, dk brn, mod. calc, some SS & silt, yellow-brow
710	720				Sh, lt - dk brn, some gray-grn, + silt, yellow-brn, mod. calc
720	730				Shale as above
730	740				Shale, dk. brn to brn-gray, slightly calcareous
740	750				Shale, dk brown, minor lt brn, mod. - strongly calc.
750	760				Shale, as above.
760	770				Shale, as above
770	780				Shale, as above, + minor ss, reddish-br w marcasite
780	790				Sh, lt. - dk brn, & siltstone, green-gray, strongly calcareous
790	800				Sh, dk brn, some green-grey siltstone, calcareou
800	810				Sh, dk brn with lt brown interbeds, very fine + minor lt gry silt
810	820				Sh, as above, mod. to strongly calcareous
820	830				Sh. as above
830	840				Sh. as above, wkly to mod. calc.
840					START CORING

HOLE NO: X - 10 SHEET 1 OF ___ DATE: 12/29/74 LOGGED BY: Moulton COLLAR: ___ TD: ___

START CORE

FROM ALL NUMBERS

BARREL EXTENSIVELY BROKEN DUE TO EXCESSIVE POUNDING

THE EARTH WITH A SLEDGE HAMMER.

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
840								OIL SHALE - DRK BRN TO BLACK
841								MEDIUM TO HIGH GRADE WITH
842								ZONES OF LOW GRADE
843			.37					
844			.14.75					
845			.10 .18					
846	+130		.18					HIGH GRADE SHALE ZONE
847			.10					
848			.11					
849			.7					
850			.25					
851		.41	.55 .90					
852		90°						LOW TO MEDIUM GRADE
853		.57	.57.05					SHALE
854								
855			.5					
856	+120		.53					
857			.30					HIGH GRADE SHALE ZONE
858			.41 .98					
859		90°	.75					HIGHGRADE SHALE ZONE
860			.05 .45					
861			.55					
862			.00 .41					LOW TO MEDIUM GRADE
863		max 90°	.00 .46					
864								
865								
866	+110							6.65-.83 SANDY LAYER OIL
867			.87					SATURATED
868								
869			.53					
870								
871								BADLY BROKEN AREA MECH.
872								MODERATE GRADE SHALE
873			.4					
874			.85					874.6-874.8 SANDY LAYER OIL SATUR
875			.73					
876	+100							876.8-877.25 SANDY LAYER OIL SATUR.
877								
878								LOW GRADE SHALE
879								
880			.12 44.5					880.0-880.18 ~~OS~~ SANDY LAYER OIL SATU
881		90°						
882								LOW TO MEDIUM GRADE SHALE
883			.07					
884			.4					884-85 SANDY LAYER OIL SATUR.
885			.82					
886	+90							
887		45°	.61					LOW GRADE SHALE
888								

HOLE NO: X-10 SHEET 2 OF ___ DATE: 12/25/74 LOGGED BY: W Morton COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
890		[illegible]	.00					LOW TO MEDIUM GRADE SHALE
891			.5					
892			.00					
893			.88					893.46 - .92 SANDY LAYER OIL SATUR
894								
895								
896	+80							896.87 - .93 SANDY LAYER OIL SATUR.
897			.10, .50					897.1 - .2 " " " "
898								
899								

HOLE NO: X-10 SHEET 3 OF ___ DATE: 12/2?/74 LOGGED BY: W. Moulton COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
900								LOW TO MED GRADE SHALE
901								901.38 - .53 SANDY LAYER OIL SAT. UR.
902			.65			[illegible]		
903								
904								
905								LOW GRADE, CREAM TO LIGHT
906	+70							BRN SHALE
907			.44					
908								
909								909.9-910.0 SANDY LAYER OIL SATURATED
910			.50					910.65-912.90 'UPPER WAVY BED'
911								MOTTLED SANDSTONE, CONTORTED BED
912								TAN-RED BRN w LIMONITE STAIN; MOD UNDULATE
913						CC 31' RQD 30.25' 12 COMM W. MOULTON		UPPER & LOWER CONTACTS
914			.30 .76					912.85 -914 OIL SHALE, GY-DK GY, FIN LAM w [illegible]
915								thin, hair-like stringers of darker material (pyrite
916	+60							
917								
918			.70					
919			.21 .45					LOW TO MEDIUM GRADE SHALE
920								WITH THIN BANDS OF DARKER
921								MATERIAL
922			.55					
923								
924								
925								
926	+50							
927								
928								
929								
930								
931								
932						933 16		
933			.16					MEDIUM GRADE SHALE WITH AREAS
934			.21					OF HIGH GRADE - SOME NAHCOLITE
935								IN VUGS AND LAYERS
936	+40							
937								
938								
939			.55					
940								LOW TO MEDIUM GRADE WITH AREAS
941								OR BEDS THAT ARE PITTED
942			.23					BANDED AREA
943								
944		X 45						
945			.53 .71					
946	+30	Zone	.72					947 - 948 MARLSTONE, buff-light gray with a few
947			.71 .93					[illegible] thin darker colored bands; very [illegible]
948			.28					947.6 948.1 } [illegible] small [illegible] white [illegible]
949			[illegible]					[illegible]

HOLE NO: X-10 SHEET 4 OF ___ DATE: 12|31|74 LOGGED BY: W MOULTON COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
950			.21 .85					GRADING INTO A ~~SHALE~~ RICHER
951			.41					LOOKING SHALE ZONE - MEDIUM
952						W. MOULTON		GRADE
953								
954								
955								
956	+20							
957			.41					
958			.86					
959								
960			.17 .59				++++	
961			.85				++++	AT 961 SANDY LAYER OIL SATURATED
962			.25					961.85-962.25 SANDY LAYER OIL SATURATED
963			.30 .73					AREA BADLY FRACTURED (MECH)
964						25.73		
965								OIL SHALE LOW TO MEDIUM GRAD
966	+10		.33					WITH BANDS OF HIGH GRADE
967								CREAM TO DARK BROWN WITH
968								BANDS OF BLACK COLORED SHAL
969								SOME NARROW SAND LAYERS AND
970			.00					LENSES
971								
972								LOW GRADE SHALE
973			.09					
974								
975			.41					975.9-976.4 MAHOGANY MARKER
976	0		.53					SANDY OIL SATURATED LAYER
977			.66					
978								
979								LOW GRADE SHALE
980			.00					
981			.27 .57					
982			.4 .84	92 .85				
983								983-985 MEDIUM TO HIGH GRADE
984								ZONE
985			[illegible] MECH					
986	-10							985-990 ~~[illegible]~~ MEDIUM GRADE
987								ZONE - SOME INNER
988								BEDDED HIGH GRADE
989								
990								
991								990-994 HIGH GRADE ZONE.
992			.4 .[illegible] .17					MAHOGANY ZONE ?
993			.01 .51 .86			9391		OIL SHALE
994			.21 .40 .52					MEDIUM TO HIGH GRADE SHALE
995			.00					DARK BRN TO BLACK - SANDY
996	-20							LAYERS FOUND IN SOME AREAS
997								OIL SATURATED
998								
999								

HOLE NO: X-10 SHEET 5 OF ___ DATE: 12/31/74 LOGGED BY: W. MOULTON COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1000		FILTH						
1001		.10 .66	.13					1001.6 - 1004 HIGH GRADE ZONE (BLACK)
1002		.36 .50	.72					
1003		.00						1003.00 - 1003.52 (SECTION OF ZERO TO [illegible] IN OIL BANDED HIGH GRADE
1004								LOW TO MEDIUM GRADE SHALE
1005								
1006	-30	.65						
1007		.40						
1008								
1009	NO FRACTURES PRESENT							1009 - 1012 MEDIUM TO HIGH GRADE
1010						12/31/74		SHALE
1011		.92						
1012								
1013								LOW GRADE SHALE
1014		.30						
1015								
1016	-40					W. MOULTON		
1017								
1018								(LOW TO MEDIUM GRADE SHALE
1019								W/SOME NAHCOLITE LAYERS
1020		.41				100%		TOWARDS THE BOTTOM.)
1021								
1022								
1023						1024.0		
1024		.35						OIL SHALE LOW TO MEDIUM
1025								GRADE WITH LAYERS OF
1026	-50							HIGH GRADE - CREAM TO
1027		.36						DK. BRN SOME BLACK ZONES
1028								SAND OIL SATURATED LAYERS
1029			.15 .55					PRESENT ALONG WITH PITTED
1030			.15 .36 .91					AREAS IN SHALE - LEACHED
1031			.16 .59					SULFIDES
1032			.23 .91					
1033			.76					1033-1034 HIGHER GRADE ZONE
1034			.77					
1035		1.00	.10 .31					1035.25-.60 SAND LAYER OIL SATURATED
1036	-60		.85			REC 30.13		185 PP IRR. IN SAND LAYER
1037			.12					
1038			.59					
1039								LOW GRADE SHALE
1040								
1041			.37					
1042			.13					
1043			.54					
1044			.40					LOW GRADE SHALE
1045			.62 .60					
1046	-70							
1047			.47					
1048			.74					1048.40 - 1049.77 SANDY LAYER
1049								CONTORTED SOME OIL

HOLE NO: X-16 SHEET 6 OF ___ DATE: 12/31 | 1/1/75 LOGGED BY: W MOULTON COLLAR: ___ TD: ___

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
1050			.23					
1051								LOW GRADE OIL SHALE
1052								
1053			.22					
1054			.41			1054.41		
1055								LOW GRADE OIL SHALE WITH
1056	-80							OIL SATURATED SAND LAYERS
1057			.99					SOME HIGHER GRADE BANDS
1058								ARE VISIBLE
1059			.95					
1060								
1061								
1062								
1063			.71					
1064			.47					1064.32 - .54 SAND LAYER OIL SATURATED
1065								SPLEDES PRESENT
1066	-90							BANDS OF HIGH GRADE
1067			.57					
1068			.00					1068-1072 OIL SATURATED AREA
1069			.62 .96			CUT 30.00' REC 30.45' 12.00 NOON W MOULTON 1/1/75		1069.62 - .36 SAND LAYER OOZING OIL
1070								
1071								
1072								
1073			.10					
1074								
1075		90°						1075.00 - 1085.00 OIL OOZING BANDS
1076	-100		.10 .52 .61 .72					FOUND IN THIS RUN
1077								↖ VERY SATURATED
1078								
1079								
1080		1081.3	.90					
1081								
1082		90°						LOW GRADE SHALE
1083								
1084		[illegible]				[illegible]		
1085			.86					HIGHER GRADE ZONE
1086	-110							
1087								
1088			.40 .55 .52					
1089			.17 .49					LOW GRADE SHALE
1090			.83			CUT 13.00' REC 12.75' 3:00PM 1/1/75 W MOULTON		
1091			.25					
1092								
1093								
1094								
1095			.15					
1096	-120							
1097			.60			1097.6		BOTTOM OF HOLE (1097.60)
1098								
1099								

HOLE NO: X-11 SHEET 1 OF 2 DATE: 14 DEC'74 LOGGED BY: N. BJORNE COLLAR: ____ TD: 1023
15 DEC'74 E. GENTZLER

FROM	TO	±MM	ASSAY 10 20 30 40	GAL/TON	DESCRIPTION
0	28				OVERBURDEN
28	40			E	SILTSTONE, lt. Brn, V. Calc, occ Biotite & Musc
40	50			C G	SILTSTONE, ditto
50	60				SANDSTONE, lt Brn to lt Gry, F. to V.f-gnd, hard, V. Calc, Much Biot. Much F. cub. py.
60	70				SANDSTONE, do
70	80				SANDSTONE, do, only slty Calc.
80	90			N	SS LT GRY NON CALC BIOTITE FLECKS
90	100			R B	SAME AS ABOVE
100	110				S.S LT. GRY NON CALC, WITH SOME SILT LT. BRN MOD TO V. CAL
110	120				SAME AS ABOVE
120	130				S.S LT. GRY NON CALC
130	140				SS LT GRY NON CALC BIOTITE FLECKS
140	150				S.S. LT GRY SLTY CALC
150	160				S.S. LT. GRY SLTY TO MOD CALC
160	170				S.S LT BR TO LT GRY MOD TO V. CALC
170	180				SS. LT GRY WITH LT BR SILTSTONE V CALC
180	190				SS LT GRY SOME SILTSTONE LT BR. MOD TO V CALC
190	200				SS LT GRY. NON CALC
200	210				S.S. LT GRY TO BRN MOD TO V CALC BIOTITE FLEC
210	220				SILTSTONE LT GRY. SLTY TO MOD CALC
220	230				SILTSTONE LT BR. MOD TO V. CALC BIOTITE AND PYRITE FLECKS
230	240				SILTSTONE LT BR TO BR. SLTY CALC
240	250				SILTSTONE LT BR TO BR NON CALC.
250	260				SILTSTONE LT GRY TO GRY NON CALC BIOTITE FLECKS
260	270				SILTSTONE LT GRY TO GRY, NON CALC
270	280			E	SILTSTONE, Med Brn-Gry, slty Calc, minor Biot., V. hard
280	290			C G	SILTSTONE, lt Brn, slty Calc.
290	300				SILTSTONE, lt Gry-Brn, Sandy (V.f-gnd), Much Biot; friable
300	310				SILTSTONE, do
310	320				SILTSTONE, lt-med Brn, Sandy (V.f-gnd), minor Biot, V hard, V. Calc.
320	330				SILTSTONE, lt-med Brn, Sandy (V.f-gnd), minor f Musc., soft.
330	340				SILTSTONE, med-lt Brn, V. hard, V. Calc., minor f. Musc & Biot.
340	350				SILTSTONE, do
350	360				SILTSTONE, do
360	370				SILTSTONE, med-lt Brn, V. hard, V. Calc.
370	380				SILTSTONE, dk Brn., V. hard, V. Calc
380	390				SILTSTONE, med. Brn, V. hard, V. Calc., minor Musc.
390	400				SILTSTONE, do
400	410				SHALE, med. Brn., V. hard, V. Calc
410	420				SHALE, med-dk Brn, V. hard, V. Calc, W/ minor V.f. Musc
420	430				SHALE, do
430	440				SILTSTONE, dk Brn, V. hard, V. Calc.,
440	450				SILTSTONE, do.
450	460				SHALE & MARLSTONE, dk Brn, V hard, V Calc., minor Musc / lt. Gry-Brn, dirty, dolo
460	470				MARLSTONE, lt Brn., silty, V. Calc., hard
470	480				SHALE, med-dk Brn, V. hard, med.-V. Calc
480	490			N	SHALE, MED-DK BRN V. HARD MOD CALC
490	500			R B	SHALE, DK BRN V HARD MOD. CALC.

① DEPTH MEASURED FROM TOP OF ROTARY TABLE, ② CASING SET TO 80'
WHICH IS 11.6 FEET ABOVE GROUND LEVEL

HOLE NO: X-11 SHEET 2 OF 2 DATE: 12/18/79 LOGGED BY: N. BJORNE E GENTZLER COLLAR: ___ TD: 1023

FROM	TO	±MM	ASSAY				GAL/TON	DESCRIPTION
			10	20	30	40		
500	510							SHALE MED BRN TO DK BRN. V HARD. NON CALC
510	520							SHALE, MED BRN TO DK BRN V HARD. SLTY CALC
520	530							SHALE MED BRN TO DK BRN HARD MOD CALC
530	540							SHALE LT BRN TO MED BRN V HARD MOD TO V CALC
540	550							SHALE LT BRN TO BRN MOD TO V CALC
550	560							SHALE DK BRN V. HARD V CALC.
560	570							SHALE DK BRN V. HARD V CALC.
570	580							SHALE LT BRN TO BRN V. HARD, V. CALC
580	590							SHALE MED BRN TO DK BR. V HARD. V. CALC
590	600							SHALE DK BRN. V HARD V. CALC.
600	610							SHALE BR TO DK BR. V CALC
610	620							SAME AS ABOVE
620	630							SHALE BRN V. HARD V CALC
630	640						N R	SHALE DK BRN, WITH SOME LT GRY, V CALC.
640	650						B	SHALE LT BRN TO BRN V. CALC
650	660						E C	SHALE, dk. Brn, silty, v. hard, v. calc, fissile to platy
660	670						G	SHALE, do.
670	680							SHALE, do.
680	690							SHALE, do.

—CORE BELOW THIS DEPTH —

HOLE NO: X-11 SHEET 1 OF 6 DATE: 12/19/74 LOGGED BY: W. Mauston COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
								OIL SHALE - (LIGHT TO MED BROWN
491.58								(LOW TO MODERATE GRADE) WITH
492			.58					LENS AND LAYERS OF SANDSTONE
493			[illegible]					AND CALCITE - NUMEROUS [illegible]
494								[illegible] SEEN IN FRACTURE[illegible]
495								
496								
497								
498			[illegible]					
499								

COMMENTS: Core depth is measured from ground

HOLE NO: X-11 SHEET 2 OF 13 DATE: 12/20/74 LOGGED BY: W MOULTON COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
700								
701		.00						
702								
703								SULFIDE FLAKES
704		.50						
705		71.85						
706		.77						OIL RICH SAND LAYER
707		16.18						
708		.68						DARKER ZONE RICHER OIL SHALE
709								" " " "
710		.03 .45				CUT 30.00' RQD 30.32' 11:00PM 12/19/74 W MOULTON		
711		.53						
712								
713		23.65						
714		.54						
715		.35						RICHER ZONE .1' W/SULFIDE FLAKES
716		.88						
717								
718								
719		20.58						
720								
721		.68				721.50		
722								OIL SHALE MEDIUM TO DARK
723								BROWN WITH SOME BLACK
724								ZONES - ~~[illegible]~~ LOW TO
725		.50				LOST CORE AT BOTTOM OF HOLE 7.34		RICH IN GRADE - SULFIDE
726	+40							FLAKES SEEN IN MOST AREAS.
727								A ~~[illegible]~~ FEW SANDSTONE LAYERS,
728								W/ BITUMEN?
729								721.88 - 722.24 BLACK SHALE ZONE
730								728-729 DARK SHALE ZONE
731		.30						
732								
733						76.39%		~~734.60 - 734.68 SANDSTONE~~
734								734.60 - 734.68 SANDSTONE
735						END 23.66 12/20/74 W MOULTON		735.0 - 735.60 DARKER ZONE, RICH OIL SHALE
736	+130							
737								
738								
739								
740						CUT 31.6? 12:00PM		
741								742.66 - 742.84, SANDSTONE
742		.60						IMPREGNATED WITH BITUMEN
743		.31						
744								~~[illegible]~~24
745						745.16		745.16 END OF CORE
746	+120							LOST CORE FROM 745.16 TO 752.~~68~~ .50
747								TOTAL OF 7.34'
748								ACTUAL CORE LOSS 745.16 - 751.78
749								TOTAL 6.62

[illegible] 745 ACTUAL 751.5

HOLE NO: Y-11 SHEET 3 OF 8 DATE: 12/20/79 LOGGED BY: N.B. +JUM COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
750								
751						751.78		CORE BEGINS AT 751.78
752						START CORE 12:15 PM 12/20/79		751.78 - 753.65 TUFF SANDSTONE MOD CAL
753			.95					753.65 - 754.0 OIL SHALE
754								754.0 - 756.25 TUFF SANDSTONE MOD CAL
755			.15					
756	+110		.25					756.25 - 756.84 OIL SHALE MED
757								DK-BRN, 756.84 - 756.91 S.S. IMPREGN
758			.32					WITH BITUMEN, OIL SHALE 756.91 - 75
759								757.0 - 757.1 S.S DK BRN
760								757.1 - 758.48 OIL SHALE
761								758.48 - 758.68 S.S.
762			762.0					758.68 - 758.89 OIL SHALE
763								758.89 - 759.05 S.S.
764								OIL - SHALE MED TO DK BRN
765						29.40 CUT / 29.22 RECOV RQD-100%		761.71 - 761.86 S.S DK BRN
766	+100		.95					764.76 - 764.82 SS
767								766.43 - 766.95 SS DK BRN SULFIDE
768								FLECKS
769			.72					
770								
771								
772			.30					
773								
774			.78					774.39 - 774.60 TUFF SANDSTONE BRN
775								775.83 - 776.14 " "
776	+90		.91					
777								
778								SHALE V. CALC
779								779.38 - 779.45 S.S.
780			.39			START CORE 4:00 PM		779.60 - 779.66, SS
781		I 90°			781.0			
782								OIL SHALE - LIGHT TO MEDIUM BROWN
783								LOW TO MEDIUM GRADE - VERY HARD -
784								CALC. WITH LAYERS OF SS -
785			.30			START CORE 6:30 PM		784.0 - .1 SS LAYER
786	+80							
787								
788								
789						100%		LOW GRADE OIL SHALE
790			.33					
791								
792						30.00 CUT / [illegible] RQD-[illegible]		
793								792.95 - 793.03 SANDSTONE UNIT W/NAHCOLITE
794			.86					793.8 - 795.7 "UPPER WAVY BED"
795								CONTORTED SAND LAYER
796	+70							
797			.10					
798								LOW GRADE OIL SHALE

HOLE NO: X-11 SHEET 4 OF 6 DATE: 12/21/74 LOGGED BY: W. Moulton COLLAR: _____ TD: _____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
800								
801								~~801-808~~ OIL SHALE - LOW GRADE MED. GRAY
802						5 TON CORE CUT 30[illegible]-[illegible] 100% REC. (10.30 PM)		WITH SOME DARKER, VERY THIN BANDS VERY THINLY BEDDED, HARD, MED CAL
803								
804								
805								805.? - 807.?, several very thin, intermittent zones of SS tuff, blue-gray
806	+60		.68					~~[illegible]~~
807								
808								
809								
810								RICHER ZONE
811	I 90° .06R 3 WAYS	.20				811.79		OIL SHALE, dark breccia, sl.-hard calc.
812								OIL SHALE - MEDIUM TO DARK
813								BROWN - SOME BLACK - WITH
814								~~LENS [illegible]~~
815								~~NAHCOLITE~~. BANDED, CALC.
816	+50							
817								MEDIUM GRADE OIL SHALE
818								
819								819-820
820								OIL SHALE - DARK BROWN TO BLACK
821								
822								
823								OIL SHALE MEDIUM GRADE?
824								
825								~~825.75-825.80~~, SANDSTONE, tuffaceous, brown; oil saturated
826	+40					[illegible]		OIL SHALE DARK BRN TO BLACK
827								(826.8-826.E) RICH ZONE
828								826.8-829.0, OIL SHALE, gray-light brown, finely laminated; competent -- hard
829								OIL SHALE DARK BRN TO BLACK
830						[illegible]		RICH ZONE
831								
832								SULFIDE LAYERS
833							xxxxx	LOW GRADE OIL SHALE ~~WITH~~ WITH INTERBEDDED
834							xxxx	LAYERS ~~OF NAHCOLITE~~ (NO)
835							xxxx	" " " "
836	+30						xxxx	
837							xxxxx	837.0 - .3 - VUG FILLED WITH NAHCOLITE (NO
838								OIL SHALE LOW TO MEDIUM GRADE
839								
840								
841						1.70		
842								Oil Shale - Light to Dark
843								Brown - Some very dark
844								Brown to Black high grade
845								zones. ~~[illegible]~~
846	+20		11.372					Lenses ~~& streaks~~.
847			11.88					Low grade to 844.85 medium
848								grade to 846.33, [illegible]
849			[illegible].41					

HOLE NO: Y-11 SHEET 5 OF 8 DATE: 12/21/79 LOGGED BY: N. BLACK COLLAR:____ TD:____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
850			849.91					849.92 — RICHER 849.61-.66 OOZING BITUMEN 849.83-850.22 RICHER
851						CUT 29.60' RECOVERED 29.42' RQD = 100%		850.85 THREE HIGH GRADE BANDS OOZING BITUMEN
852								851.71
853			852.95					MEDIUM GRADE ?
854								
855								854.75
856	-10							855.63 - 855.87 TUFFACEOUS SS BANDS & LENSES
857								856.18 — 856.93 - 856.66 TUFF. SS MEDIUM GRADE ?
858								857.55
859								
860			859.60					
861								LOW GRADE OIL SHALE
862								
863								
864								
865								
866	0		865.82					865.57 866.03 MAHOGANY MARKER
867								VERY HIGH GRADE - OOZING MUCH DARK BROWN BITUMEN
868			867.08 867.57					LOW GRADE
869								INCREASING IN GRADE FROM
870								AROUND 869
871			870.40			871.12		870.70 ← MAHOGANY ZONE 870.85 TUFFACEOUS SS BANDS
872								RELATIVELY HIGHER GRADE
873						START CORE 1345 12/21/79		872.95 OIL SHALE - LIGHT
874			873.60					TO DARK BROWN [illegible]
875								HIGHER GRADE SECTION
876	-10		875.38 875.57 876.35					INTERMITTENT THIN SS LENSES
877								MEDIUM HIGHER GRADE
878								877.83 - 877.91 SS [illegible]
879								
880			879.65 880.00					880.00
881		15°	880.85			CUT 31.70' RECOVERED 30.22' RQD 26.98/30.22 = 85.94%		880.64 HIGHER GRADE 880.80 LOST CORE
882			881.17 881.95					HIGHER GRADE TO 882.66 ONLY
883								882.66 883.00 ← *DISREGARD H G. 882.66-883.
884								883.47 LOST CORE 883.75 ← BROKEN CORE
885								
886	-20							HIGHER GRADE
887			886.70 886.95					
888								888.06
889								
890			889.55					MEDIUM GRADE
891			890.7					890.7 890.83 HIGHER GRADE
892								MEDIUM GRADE 891.90 891.83 SS W/ CALCITE & FILLED OIL FRACTURES
893			892.97					892.23 892.75 LOST CORE 893.97 BROKEN CORE
894								
895								MEDIUM TO HIGHER GRADE
896	-20							
897								896.71
898								MEDIUM GRADE

HOLE NO: X-11 SHEET 6 OF 8 DATE: 12/22/79 LOGGED BY: W. Moulton COLLAR: ______ TD: ______

DEPTH	±MM	FRX	PP	ASSAY 10	20	30	40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION	
900			899.57						STOP CORING 9:45 pm		899.77	
901											HIGHER GRADE	
902											901.89	
903			.25 .15						902.82		SS. LENSES @ 901.12, 901.22, 901.45, 901.85, 902 902.5 · 904.33	
904			.33						START CORING 6:50 pm 12/21/79		HIGHER GRADE SHALE	OIL SHALE MEDI
905			.00 .64									TO HIGH GRADE:
906	-40		.40									MEDIUM BROWN TO
907			.76								MEDIUM GRADE	BLACK. ~~SHALE~~
908											SHALE	[illegible]
909											~~[illegible]~~	[illegible]
910			.43									OF NAHCOLITE
911												
912												
913											MEDIUM GRADE OIL SHALE	
914											WITH SOME HIGH GRADE	
915											BANDS	
916	-50		.48									
917			.85									
918			.75									
919			.51									
920			.75								MEDIUM GRADE OIL SHALE	
921			.22 FIG .71									
922		90°	.31 .53 .80									
923			.33						CUT 30.00' RQD 30.12' 1:00 AM 12/22/79			
924			.07 .80									
925			.50									
926	-60		.10								MEDIUM GRADE OIL SHALE	
927		90°	.0 .59									
928			.40									
929			.28									
930			.80								MEDIUM TO HIGH GRADE SHALL	
931			.75									
932			.67 .94						932.44		NO SAND LAYERS IN RUN.	
933			.20								OIL SHALE LOW TO MEDIUM	
934											GRADE ~~LIGHT~~ WITH LAYERS	
935			.29								OF HIGH GRADE - LIGHT BRN.	
936	-70										TO BLACK SOME LAYERS	
937			.35								OF NAHCOLITE AND SANDSTON	
938											SANDSTONE LAYERS OOZING	
939									CUT 30.50' RQD 30.3' 12/22/79 6:45 AM		BITUMEN OIL	
940											940.59 - .73 940.82 - .90 SANDSTONE LAYER OIL SATURATED	
941												
942												
943												
944											MEDIUM TO LOW GRADE	
945											OIL SHALE	
946	-80											
947												
948												
949												

THE CLEVELAND-CLIFFS IRON CO. PROJECT [illegible]

HOLE NO: X-11 SHEET ~~8~~ 7 OF 8 DATE: 12/22/76 LOGGED BY: W. MOULTON COLLAR: ____ TD: ____

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
950								OIL SHALE
951								LOW TO MEDIUM GRADE
952	~~I-16~~	I 90°						
953			.39					
954								
955								
956	-90							
957								
958							++++	SANDSTONE ~~LENS~~ LAYERS 958.1 - .25 OIL SATURATED
959								
960								NUMEROUS THIN SANDSTONE ~~LENS~~ LAYERS
961								OIL SATURATED INNER BEDDED WITH
962								LOW GRADE OIL SHALE.
963			.50			963.24	++++	thin ss. bleeding tar with pyr } 96.2 - 96.8
964							++++	thin ss. bleeding tar } Low grade oil
965								shale, silty, finely laminated, sl. calc
966	-100		.60				contorted	with thin zones & seams
967								that are oil or tar saturated
968								968-970 oil shale, lt brn low grade
969			35 .65					
970		15°	80 .20				++++	thin ss: ss - oil saturated
971			.20					970.5 - 971 oil saturated shale.
972						Cut 29.56 ft, Recov. 30.22 ft. FINISHED CORING RUN @ 11:00 AM		Shale, low to med. grade,
973								competent, non-calc, silty, finely
974								laminated
975			.40					Same as above with thin zones of
976	-120							oil bleeding
977								Shale, low grade, lt gy - buff
978								silty, competent, sl calc.
979								
980								
981								
982								
983			.25 .35 .70					Shale, low grade, cream to buff
984			30 .60					Surface has "pitted" look, several
985		85°	.80					parting planes, non-calc
986	-130	I 90°						Shale, low grade, gray, fine grained than
987								above.
988			.70					OIL SHALE, med grade, brn-dk brn
989								fine grained, finely laminated, some
990			.50					mildly distorted bedding (around blebs)
991								SHALE, very low grade, lt gray,
992							17.28	finely laminated
993			.00					
994	-134							

NOTES: Miller [illegible] ft [illegible] 30.24 - Kelly Measurement indicates [illegible] of core recov = 30.2 [illegible] a diff of 0.6 ft (too much) — suspect [illegible] will be in error but driller [illegible]

THE CLEVELAND CLIFFS IRON CO. PROJECT:

HOLE NO: [illegible] SHEET 8 OF 8 DATE: [illegible] LOGGED BY: [illegible] COLLAR: TD:

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/TON	REC. & RQD	LITH.	DESCRIPTION
992.						992.[illegible]		
93								LOW GRADE LT. BR. OIL SHALE
94								BEDDING MARKED BY THIN
95			.50					SS LAYERS & BLEBS
96								993.4 OIL SAT.
97			.31					
98								PYRITE BLEBS
99			.60					
1000			.03 10 [illegible]	[illegible]				
1			15 [illegible]					PYRITE BLEBS, 1001.8 - 1002 SS
2								LT BROWN LOW GR. OIL SHALE
3								
4			.05					
5								SS OIL SATURATED
6			13.6					
7								
8			.56			[illegible]		
9			.25					1009.5 OIL SATURATED
1010						[illegible]		LENSES OF PYRITE 1010.3 OIL SAT.
11			.22 [illegible]					1011 - 1012 DARK BANDS
12								"
13								
14			.92			[illegible]		"
15								
16			.50					"
17			[illegible]	[illegible]				
18								THIN SS.
19			[illegible]					
20								
21			.90					
22								
23								
						1023		HOLE COMPLETE

VI. HISTORIC AND SCIENTIFIC INVESTIGATIONS

VI. HISTORIC AND SCIENTIFIC INVESTIGATIONS

NO DATA THIS QUARTER